A McGRAW-HILL PUBLICATION
OCTOBER 1960
TWO DOLLARS

Power

the magazine of energy systems engineering

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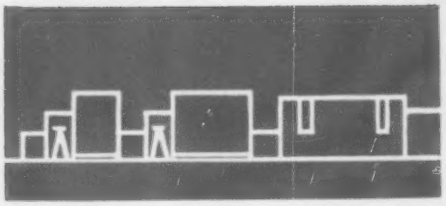
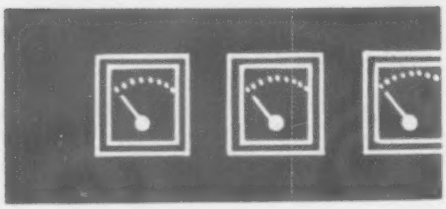
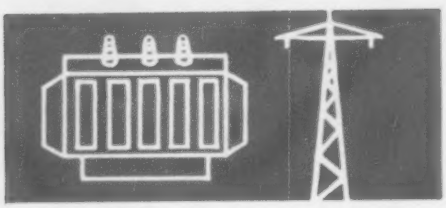
PLANT DESIGN ISSUE

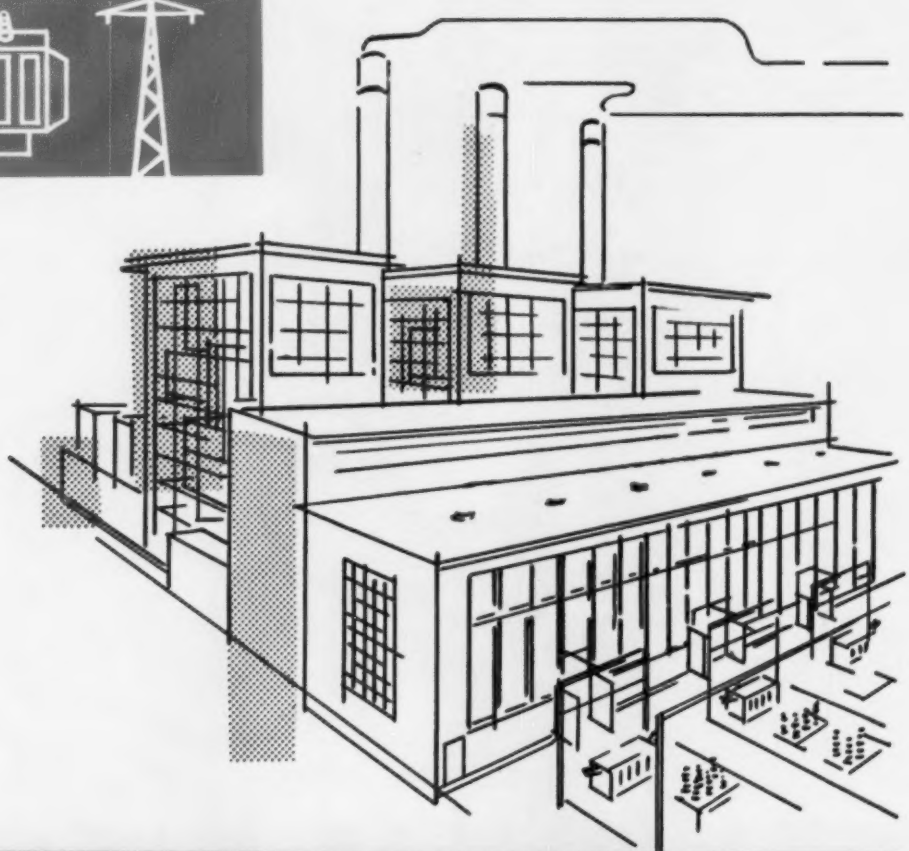
AEG







For 75 years, from the first small plant which supplied houses with electric light to the hundreds of power stations throughout the world that supply cities, industries and railways, AEG experience and coordinated design have served to maintain highest quality and dependability of equipment.



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For more facts circle 776 on Reader Service card, p 207

Want minimum maintenance on a dual-fuel engine? —STANODIESEL Oil M

Stafford, Kansas Light Plant finds this lubricant helps hold down maintenance and operating expense

Bill Ray, (left), Standard Oil lubrication specialist calls on Stafford city superintendent LeRoy Priess. Rendering technical assistance to customers such as this is Bill's job. He is qualified for it through seven years' service with Standard Oil Company. Bill is a graduate of Wichita University.

Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by economy fuels.
- Maintains film on difficult-to-lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.

From February, 1953 to April, 1959 a 1,280 hp., 720 rpm., dual-fuel engine at the Stafford, Kansas Municipal Light Plant generated more than 12.5 million kilowatt hours in 29,780 hours of operation. At the end of this period the top piston rings were replaced; however, the amount of wear was almost too small to measure. Rings, pistons and cylinder walls showed only a negligible amount of carbon and varnish. Lube oil consumption was 7,399 gallons or 1,697 kw. hours per gallon.

You can get this kind of service with STANODIESEL Oil M. The oil's superior base stock, coupled with its additives gives you these maintenance and operating savings: low oil consumption, reduced port deposits, fewer stuck rings, less need for ring replacements, less cylinder wear, lower filtration costs and fewer bearing problems.

Learn more about STANODIESEL Oil M. Call the Standard Oil office near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

STANDARD

You expect more from STANDARD and you get it!

Piston after 29,780 hours. Virtually no carbon deposits or varnish are visible.

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OCTOBER 1960 • VOL. 104 • NO. 10 • 78TH YEAR

Power

speaking of Power

Do you know the meaning of the insignia at the top of this column? You should, because they are important to you as a reader of technical and business magazines.

"ABP" stands for Associated Business Publications, and for our pledge to abide by its *Code of Ethics and Standards of Practice.* It is highly significant that the very first principle set forth in that pioneering code is *"To consider, first, the interests of the subscriber."* While everything in the Code is important to good publishing—and, therefore, to publishing integrity—this initial principle is the one that gives the ABP symbol its meaning to you, the reader.

The "ABC" symbol, the right-hand companion in the insignia above, tells you that POWER is a member of the Audit Bureau of Circulations. As members, we twice a year open POWER's subscription records to an independent, unbiased audit by ABC representatives. In addition to guaranteeing our advertisers a verified, completely honest circulation, the ABC symbol also proclaims that all our subscribers are treated alike—and treated fairly. Circulation sales methods are rigidly controlled and must meet the highest standards of the publishing profession.

Thus, when you see the ABP and ABC symbols on a magazine page, you see a publication based on a solid rock of service to its subscribers. And because we believe in this principle—and live by it—we have no hesitation in making the unconditional guarantee that you will find in the indicia at the bottom of the facing page.

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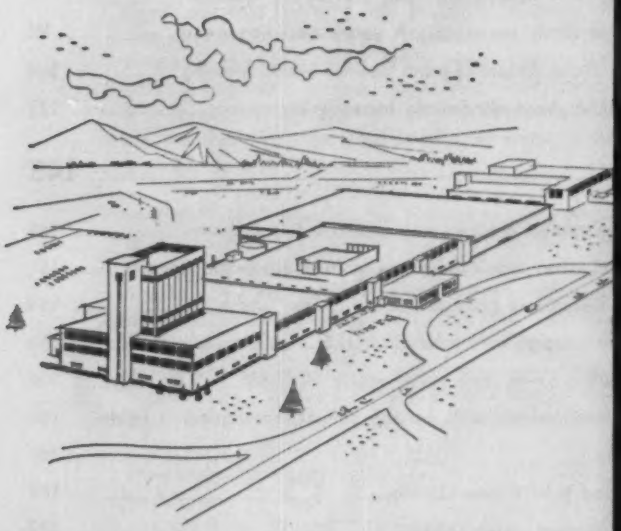
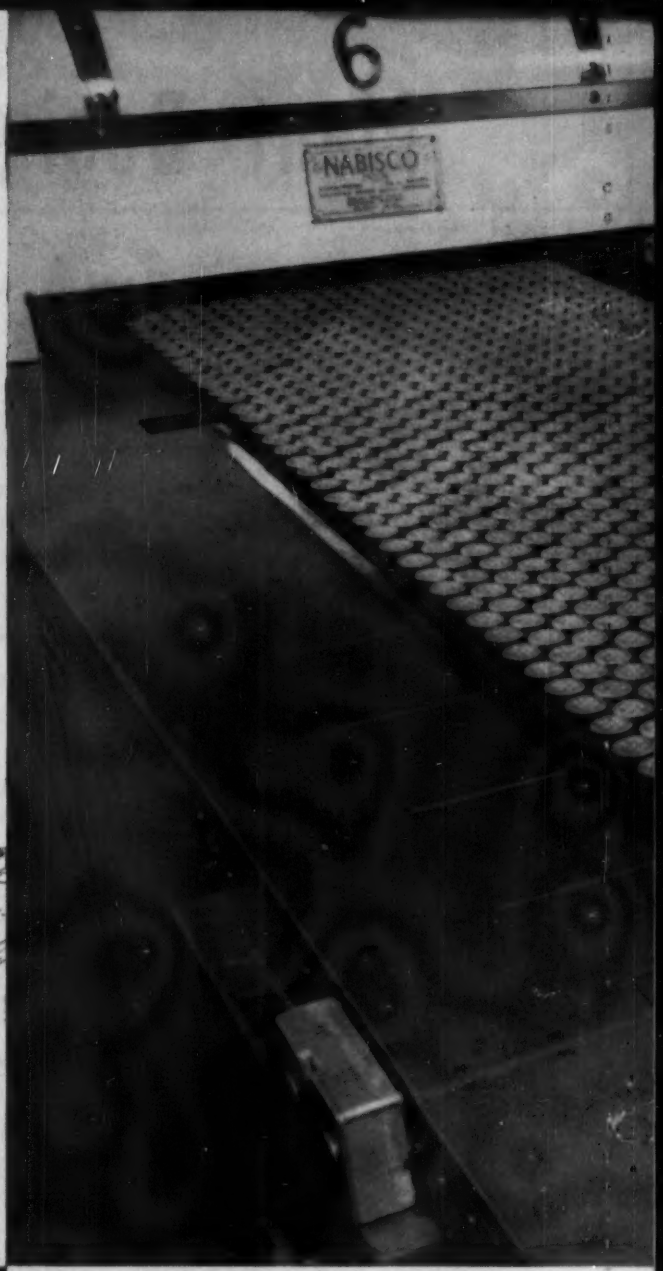
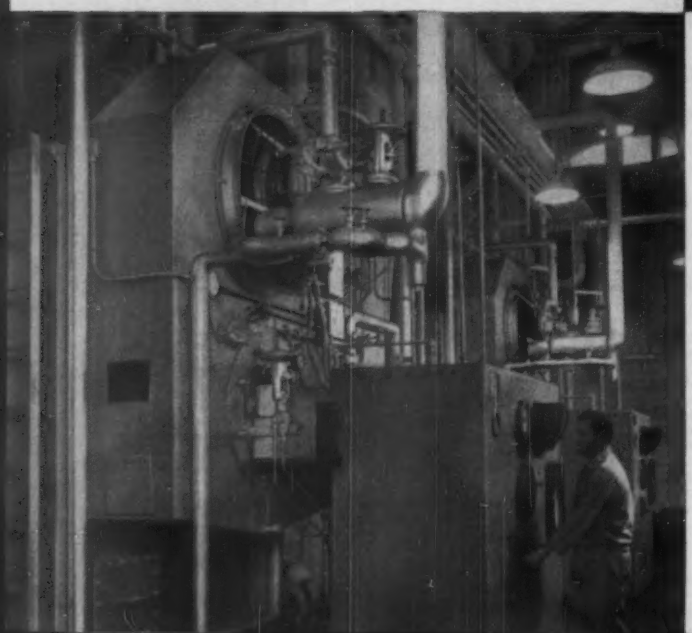
5 Million Cookies an Hour







Nabisco relies on B&W Package Boilers to supply heat for buildings and steam for all of their process requirements where giant ovens produce 177 million pounds of bakery products annually.

In Nabisco's $15,000,000 plant at Fair Lawn, N. J., three B&W Package Boilers are used to heat the plant, and to supply steam for process equipment. Operating at 130 psi and 338 F, the three oil-fired boilers deliver a total of 84,000 lb of steam per hour. Each of the plant's ovens are the length of a football field and these immense bake-ovens process up to 5,600,000 cookies an hour! Needless to say, dependable process steam supply is a must in this massive baking operation. That's why Nabisco selected B&W Package Boilers to provide the needed steam.

Dependability, however, is only part of the story. Budget-minded Nabisco management has found the cleanliness of

operation, high fuel economies, flexibility, rapid response to demand, and maximum capacity in minimum space afforded by B&W Package Boilers equally attractive features. They also appreciate the assurance that B&W's nationwide service organization will be promptly and economically available if needed—at *any* time during the life of the boilers.

Supplying heat and process steam for a modern baking plant like Nabisco's is further evidence in action of dependable steam generation by B&W. Whatever *your* steam requirements... whatever your most economical fuel, B&W has the boiler best suited to your application. Your local B&W representative has all the facts on your area. Call him soon. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B & W—THE NATION'S LEADING MANUFACTURER OF INDUSTRIAL BOILERS

G-979-1B

B&W

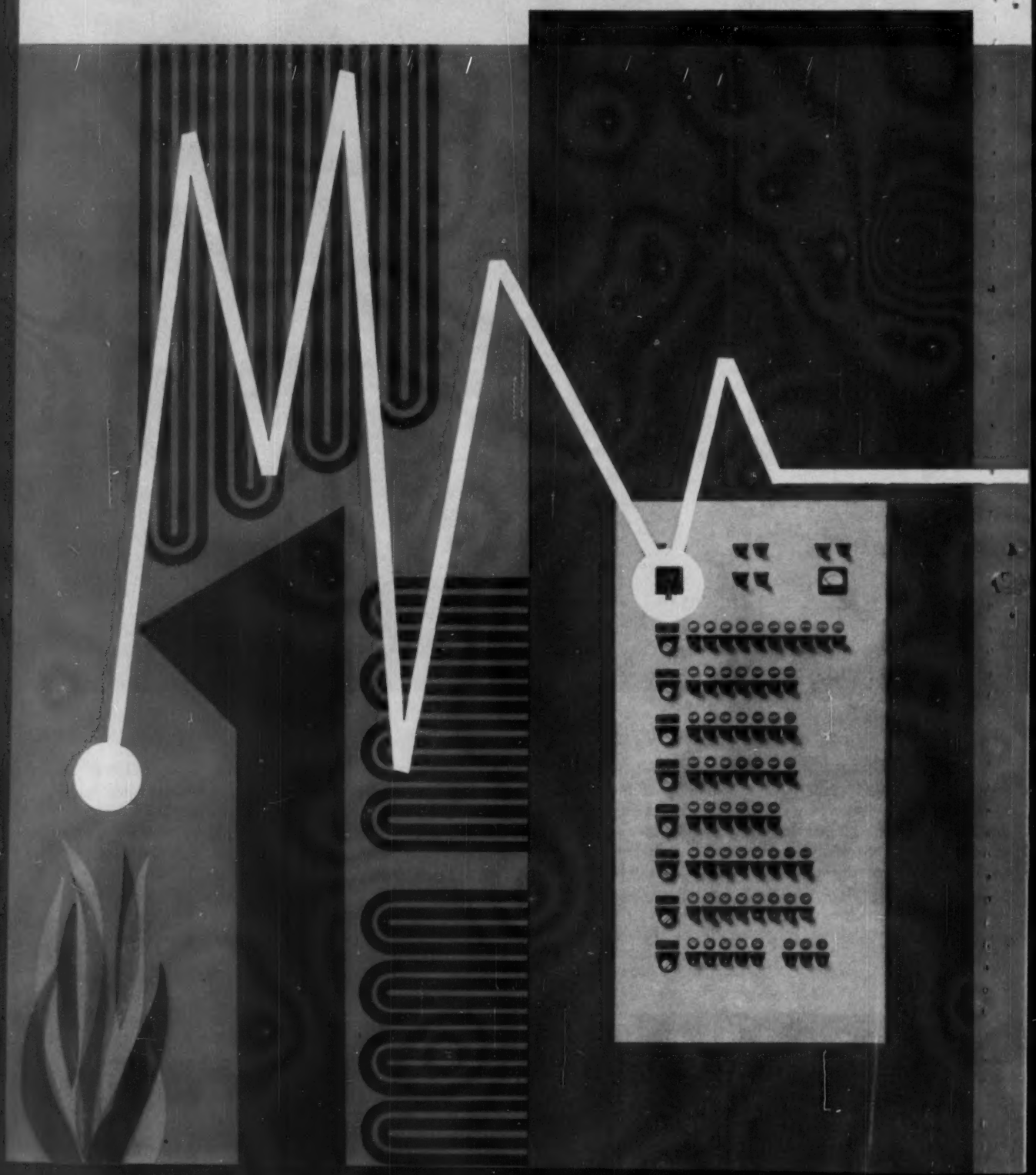
THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

For more facts circle 780 on Reader Service card, p 207

Diamond developed for more economical power

MONITORMATIC...NEW SELF-CONTROL FOR MORE EFFICIENT BOILER CLEANING



Optimum frequency of blower cycling is assured with Monitormatic . . . Diamond's completely automatic boiler cleaning system.

Monitormatic is an automatic method of maintaining constant furnace cleanliness and heat absorption. It responds automatically to changing boiler conditions and eliminates indiscriminate, unnecessary or insufficient blowing. Savings are realized through optimum use of blowing medium, minimized soot blower maintenance, less compressor maintenance if air is used as blowing medium, and reduced operator time. It also automatically adjusts the cleaning system to fuel changes.

Monitormatic is readily and economically applicable to new or many existing Diamond Selectromatic Systems; is another example of why "Diamond Developed" means more economical power generation.

At your request, our Engineers will be pleased to evaluate the application of Monitormatic to your specific system. Call, write or wire for complete information.

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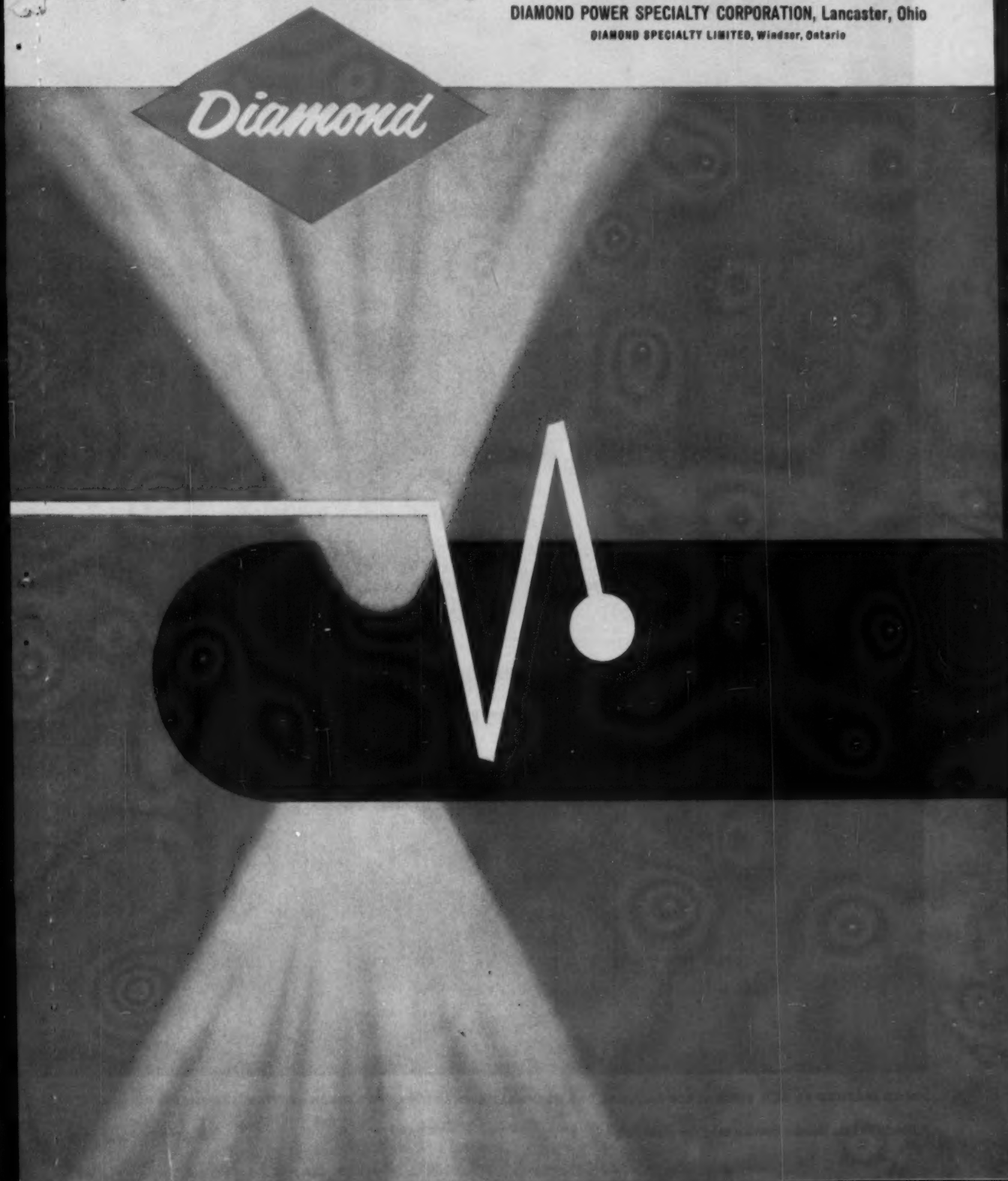

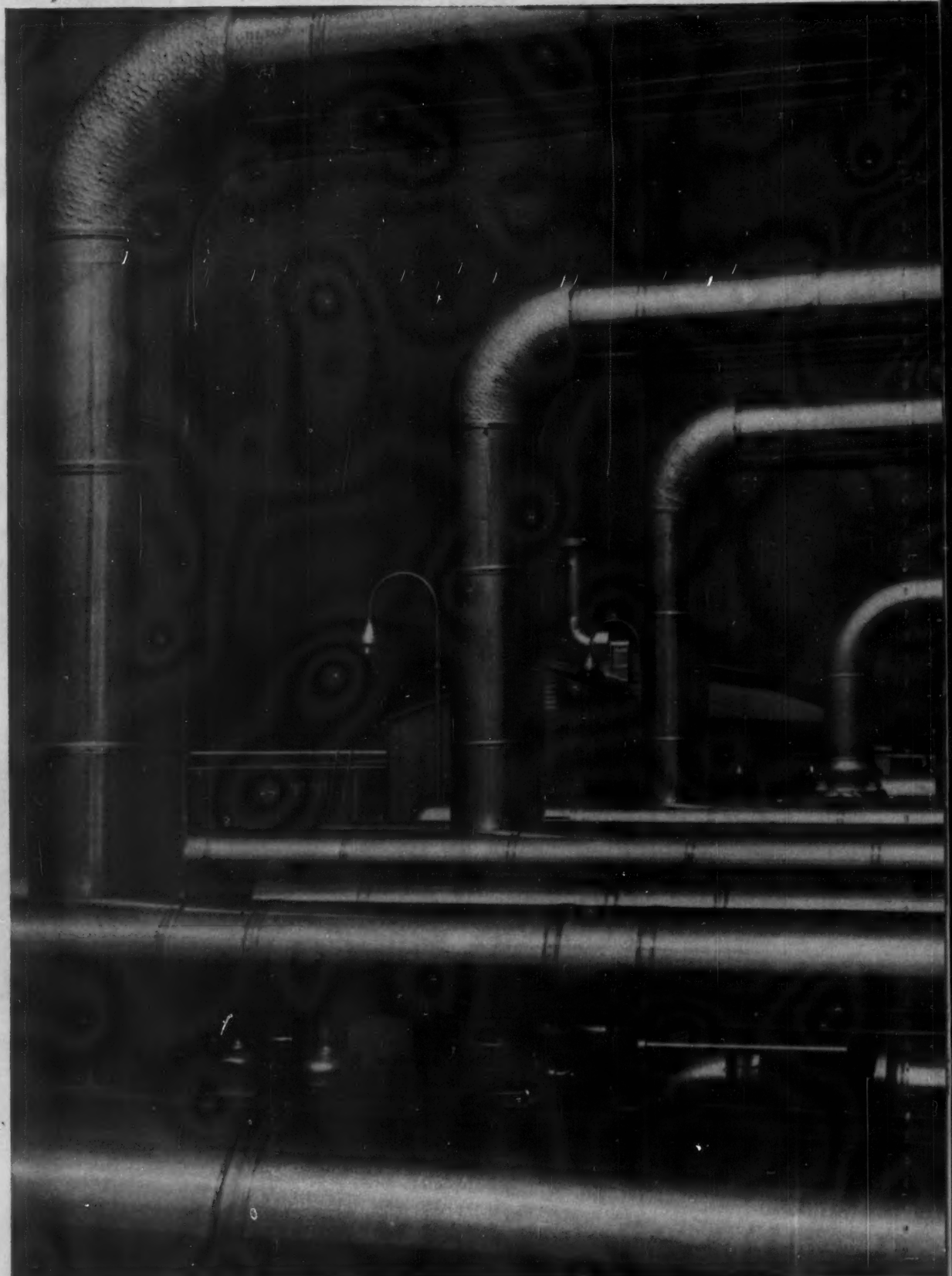

PHOTOGRAPHED AT NEW YORK STATE NATURAL GAS CORPORATION'S LEIDY COMPRESSOR STATION, TAMARACK, PA.

◀ Circle 781 on Reader Service card for preceding ad

Installation time at Leidy Station cut 25% with prejacketed J-M METAL-ON® pipe insulation!

"ALMOST 2 MILES OF METAL-ON PROTECTS OUR OUTDOOR PIPELINES. THIS IS THE BEST—AND BEST-LOOKING—INSULATING JOB I'VE EVER SEEN,"
says head station engineer VICTOR CUMMINGS

Leidy Pool, with an ultimate storage capacity of 105.6-billion cubic feet of natural gas, is served by a compressor station incorporating almost two miles of outdoor pipelines. Both lines and equipment must be completely protected against northern Pennsylvania's violent winter storms, torrential spring rains and summer heat. Metal-On jacketing, developed by J-M, was chosen to handle this difficult job.

Metal-On is prefabricated at the factory in 36-inch lengths. Each length combines high-temperature J-M Thermobestos insulation . . . a moisture barrier . . . and a special aluminum alloy jacket. And because each length can be applied in one simple operation, erection time savings at Leidy averaged 25%! Metal-On can also be easily cut on the job with portable power or hand saws. Cutouts for hangers and supports are simple to make.

Maintenance savings can be very impressive, too. Metal-On doesn't corrode, needs no painting. The rugged jacketing, combined with a locking device that snaps closed and seals joints, will lock out weather and moisture permanently. And each section can be easily removed for trouble-shooting.

You may not have *two miles* of pipeline . . . but if you have a tough outdoor insulation problem, it will pay you to investigate J-M Metal-On. Just write to Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

METAL-ON:
JUST MINUTES FROM CARTON TO PIPE!

JOHNS-MANVILLE
AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE

JOHNS-MANVILLE JM PRODUCTS

For more facts circle 782 on Reader Service card, p 207

KEY to functions performed by Bailey 700 Systems

A — Analog A/D — Analog and Digital
D — Digital s — sense and measure
d — display (indicate, record and/or log)
m — monitor (scan and alarm)
p — produce stored information for future use (tape, cards) c—compute r—control

● Installed ● On order

LOCATION	TYPE	FUNCTIONS
1. Chelan Co., Wash.	D	sdm
2. Chelan Co., Wash.	D	sd
3. San Francisco	A	sdc
4. Salinas, California	A	sdc
5. Los Angeles	A	sdc
6. Glendale, Ariz.	A	sdc
7. Alameda, N. M.	A	sdc
8. Amarillo, Texas	A/D	sdmc
9. Smithers Lake, Tex.	A	sdr
10. Orange Co., Tex.	A/D	sdmcr
11. Bronte, Tex.	D	sdm
12. Sioux Falls, S. D.	A	sdr
13. Oklahoma City	A	sdc
14. Harrah, Okla.	A	sdc
15. Muskogee, Okla.	A	sdc
16. Lafayette, La.	A	sdc
17. Jackson, Miss.	A	sdc
18. Cleveland, Miss.	A	sdc
19. Memphis, Tenn.	D	sdm
20. Paducah, Ky.	D	sdc
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28. Fairless Hills, Pa.	D	dm
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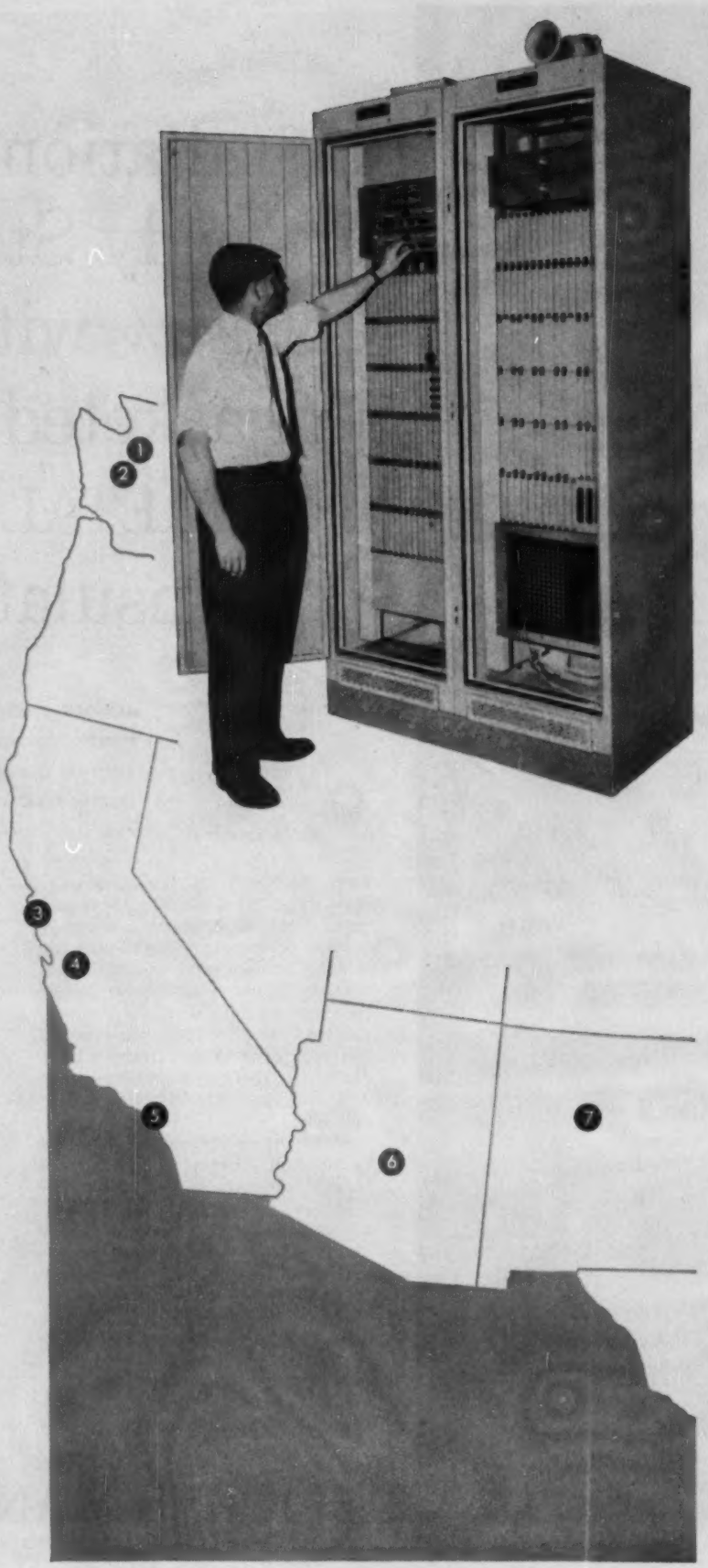

BAILEY 700

ANALOG AND DIGITAL SYSTEMS IN ACTION

Installed or under construction, Bailey 700 Analog and Digital Systems are IN ACTION TODAY from coast to coast, providing integrated instrumentation systems accurately tailored to specific needs.

Note the variety of functions performed in these installations. Basic ingredients of all are electronic modules housed in standardized electrical cabinets, as shown here. This permits any combination of control, information or computing system elements to be combined and expanded as required to perform specific functions in individual installations. Wiring and maintenance is simplified —operator's console is freed of bulky equipment.

Ask your local Bailey engineer to arrange a visit and demonstration of a Bailey 700 System located near you, or at Cleveland. Or get IMMEDIATE details on the installation of greatest interest to you, by TWX—just jot down the number of the location you select on message form below and hand to your secretary. Reply will be transmitted at end of your message.

G153-2

QUICK FACTS BY TWX . . .

For name and IMMEDIATE details on installation of greatest interest to you, fill in number of location from map and have your TWX operator send this message:

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PROCEED IMMEDIATELY WITH REPLY AT CONCLUSION OF THIS MESSAGE.

Name_____ Title_____

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City_____

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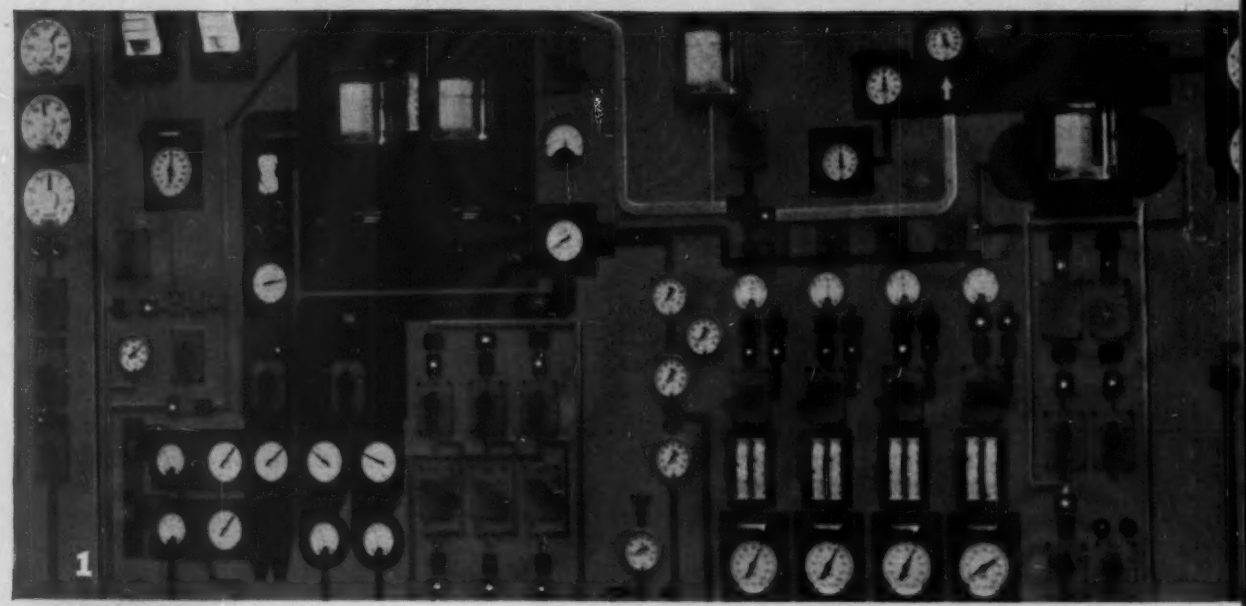
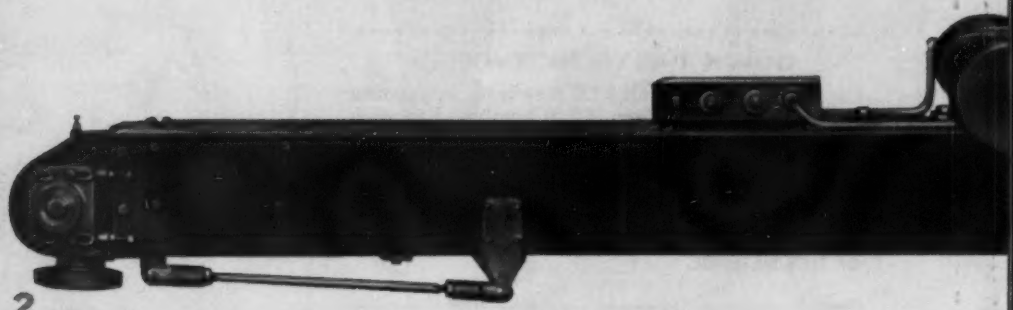
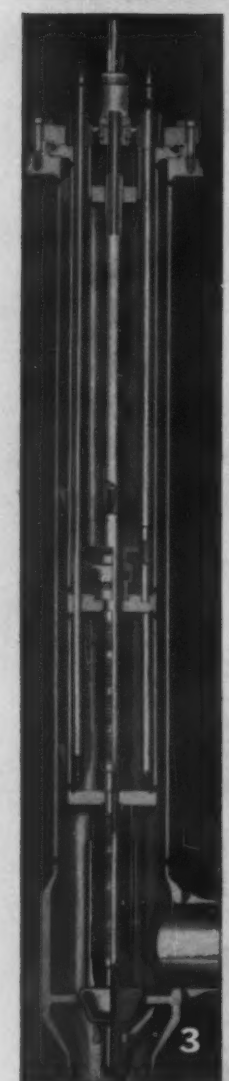
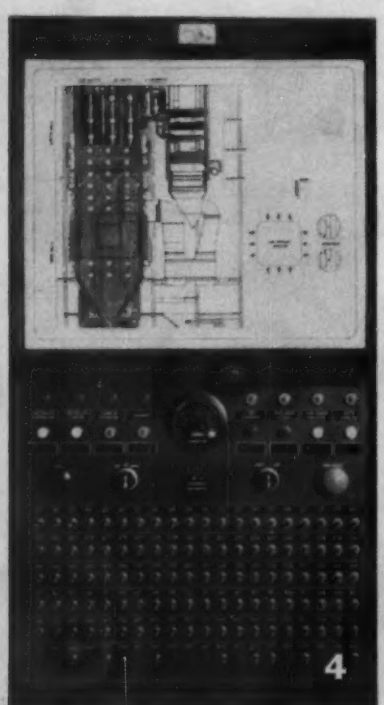
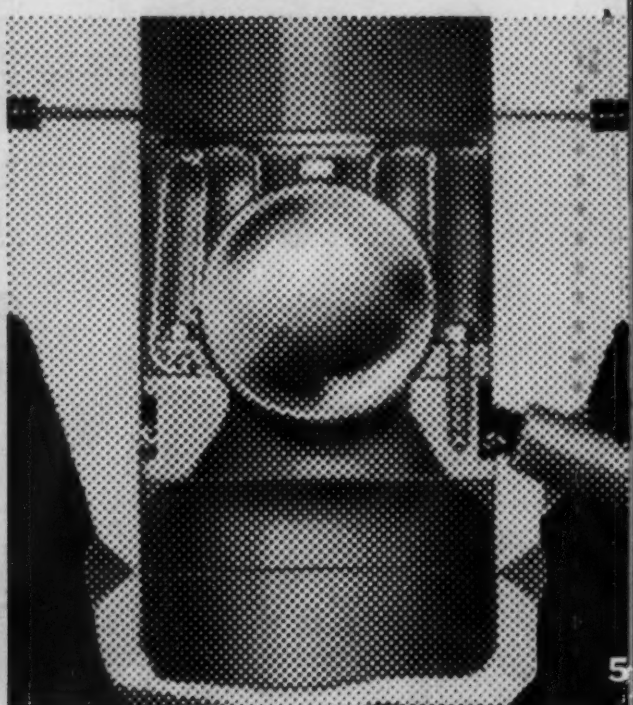
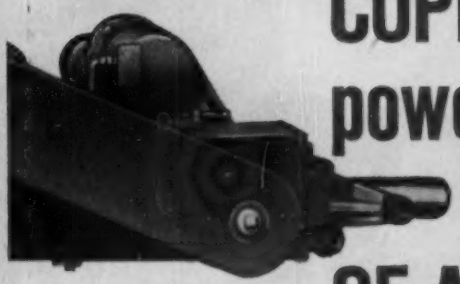












COPES-VULCAN increases power plant efficiency with NEW CONCEPTS OF AUTOMATIC CONTROLS

These are concepts of control from Copes-Vulcan. They range from **1** integrated boiler control systems that coordinate combustion, feedwater, boiler steam temperature, and boiler cleaning . . . to **2** a dual motor design that gives long retractable soot blowers their remarkable double helix cleaning pattern . . . to **3** unique liquid-sodium flow controls engineered and built to meet the industry's most challenging requirements . . . to **4** Selective-Sequence remote control for efficient programming of automatic boiler cleaning . . . to **5** greater accuracy in desuperheating control through an exclusive, Variable-Orifice design. Concepts of control, such as these, have increased efficiency in conventional, super-critical, and nuclear power plants on land and sea. To put this ingenuity to work for you on your next power project, write Copes-Vulcan Division in Erie, Pennsylvania.

Copes-Vulcan Division

BLAW-KNOX

For more facts circle 784 on Reader Service card, p 207

DEVELOPED BY PHELPS DODGE

CUFENLOY-30... DRAWN, STRESS-RELIEVED CONDENSER TUBES THAT OFFER IMPROVED PROPERTIES... CUT BUNDLE COSTS!

Approved under ASME Code for unfired pressure vessels

Cufenloy-30 tubes emerging from annealing furnace after special heat-treating operation

New, high strength Phelps Dodge Cufenloy-30 condenser and heat exchanger tubes are the result of years of intensive Phelps Dodge research devoted to improving the properties of copper base alloys.

Cufenloy-30 (copper-nickel alloy containing nominally 70% copper and 30% nickel) properties offer OEM and re-tubing users these important advantages:

1. Increased tensile and yield strength for up-to-800°F. metal temperature.

2. Thinner tube walls, when substituted for annealed cupro-nickel 30%, that reduce total tube bundle weight as much as 15% with consequent lowering of cost per bundle.

3. Cost reduction up to 50% per bundle without any sacrifice of safety when substituted for the annealed 65/35 nickel-copper alloy.

Cufenloy-30 tubes are fabricated by a special Phelps Dodge-developed drawing and heat-treating process that is unique in the industry. Test data on this improved tube was thoroughly evaluated by an independent research institute and final results submitted to The American Society of Mechanical Engineers. Under case num-

Comparison of minimum wall thickness of ⅜" O. D. tubes of various alloys when made to ASME code requirements.

Alloy	ASME Allowable Stress Values, psi At Design Temperatures 450°F	600°F	Design Pressures, psi	Minimum Wall Thickness (inches) to comply with Allowable Stress Values ⅜" O. D. Tube at 450°F	at 600°F
70/30 Copper-Nickel (Annealed)	10,100	9,600	2,000 3,000 4,000	.0574 .0829 .1070	.0600 .0868 .112
Cufenloy-30 Drawn, Stress-Relieved	15,400	14,600	2,000 3,000 4,000	.0385 .0565 .0735	.0408 .0593 .0772
65/35 Nickel-Copper (Annealed)	14,750	14,700	2,000 3,000 4,000	.0400 .0586 .0762	.0404 .0590 .0767

ber 1266 the ASME Boiler and Pressure Vessel Committee unanimously approved Cufenloy-30 tubes for use in ASME unfired pressure vessel code applications. Also the ASTM B-5 Committee has included the Cufenloy-30 alloy in the B-111 specification for copper alloy condenser tube.

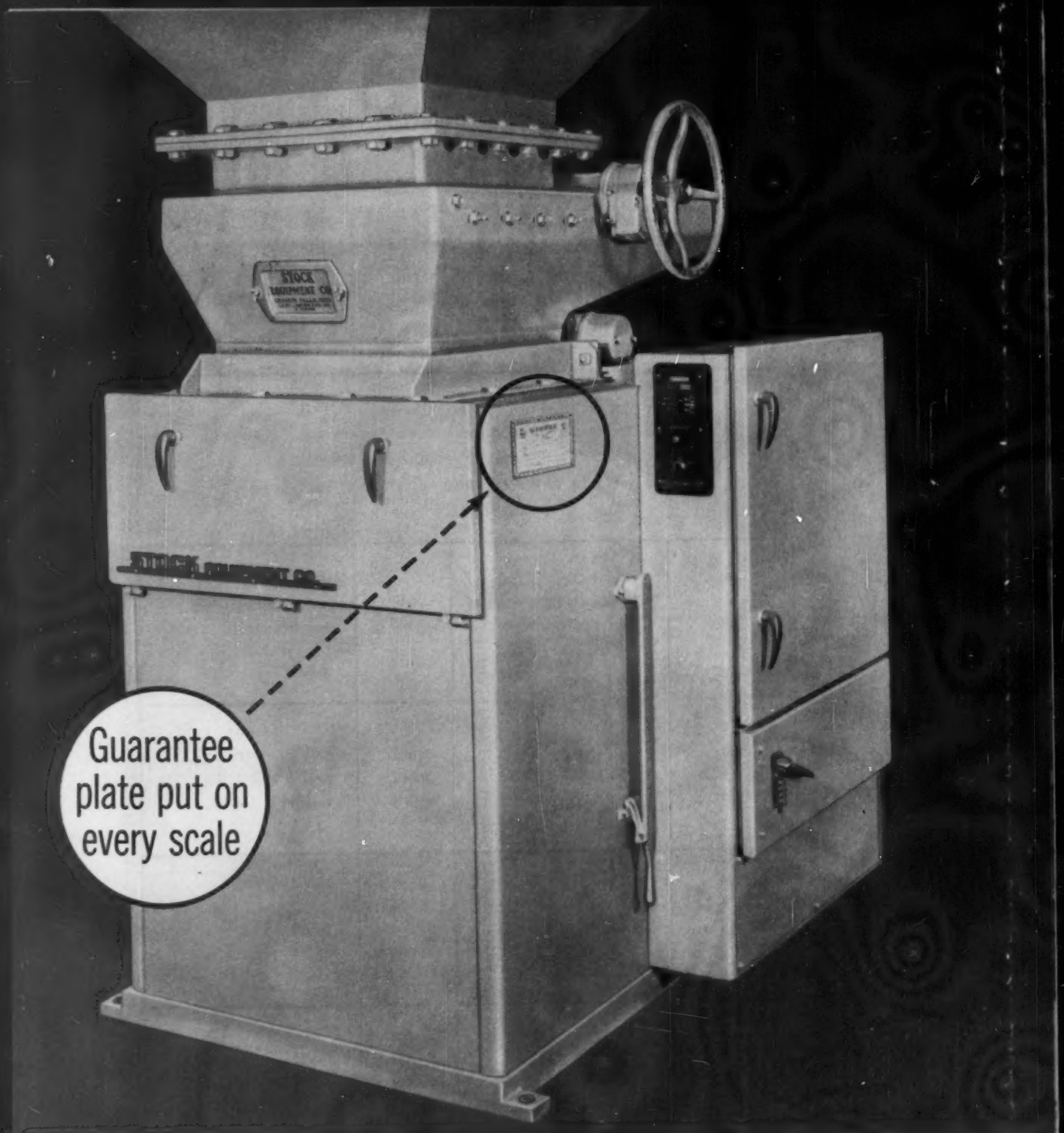
Cufenloy-30 tubes, in drawn, stress-relieved condition, are available in all standard condenser and heat exchanger sizes, in famous Phelps Dodge uniform bore Dual Gauge and in "U" bend tubes. For further information, contact your local Phelps Dodge sales office or write Dept. P-2 for the Cufenloy-30 technical brochure.

PHELPS DODGE COPPER PRODUCTS
CORPORATION
300 Park Avenue, New York 22, N. Y.

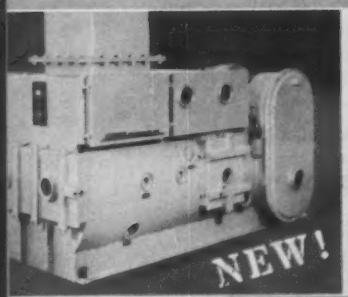
PD

For more facts circle 785 on Reader Service card, p 207

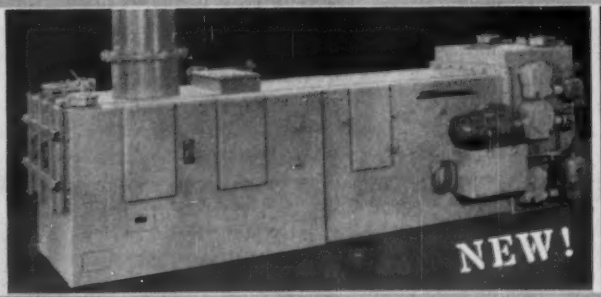
Circle 786 on Reader Service card for following ad ▶



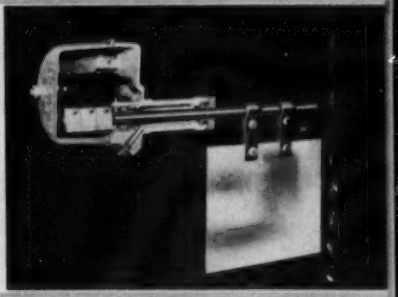
S-E-Co. QUALITY PRODUCTS



GRAVIMETRIC FEEDERS
Weigh and Feed



VOLUMETRIC FEEDERS
Feed Sticky Coals



STOPPAGE ALARMS
Two Types

STOCK EQUIPMENT COMPANY

NOW GUARANTEES

S-E-Co. COAL SCALES FOR 5 YEARS

5 YEAR
GUARANTEE
5 YEAR
S-E-Co. COAL SCALES ARE GUARANTEED FOR FIVE YEARS FROM DATE OF SHIPMENT. WE WILL REPLACE WITHOUT CHARGE, F.O.B. OUR PLANT, ANY PART THAT FAILS OR WEARS OUT UNDER NORMAL OPERATING CONDITIONS. OLD PART TO BE RETURNED. BELTS WILL BE REPLACED ON AN ADJUSTED LIFE BASIS.
STOCK EQUIPMENT COMPANY, 731 HANNA BLDG., CLEVELAND 15, OHIO
SCALE NO. 3362
GUARANTEE EXPIRES 10-29-65

S-E-Co. Scales have always been built to last, with a minimum of Maintenance, the life of the boiler plant. Analysis of repair parts sold during the first five years of life indicates that the dollars of parts sold per year is very small – most of these parts were for stock purposes. No parts for any purpose whatever were sold for 25% of the scales.

Stock Equipment Company, to prove the quality of S-E-Co. Coal Scales now guarantees S-E-Co. Scales for a 5-year period. This is being done without any price change since the expected cost of this guarantee is almost zero.

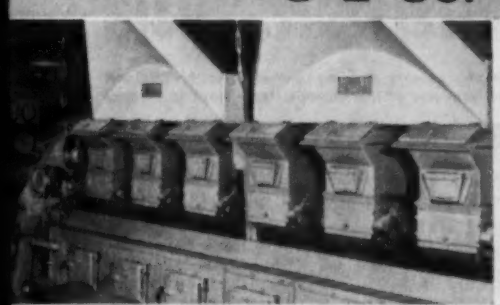
This guarantee applies to all scales shipped after October 1, 1960. The guarantee, etched on a plate, will be attached to each scale in plain sight so the man who buys parts knows of its existence.

For your next coal scale job why not buy the top quality. Buy S-E-Co. with a 5-year guarantee.

STOCK EQUIPMENT COMPANY

727 HANNA BUILDING • CLEVELAND 15, OHIO

S-E-Co. QUALITY PRODUCTS



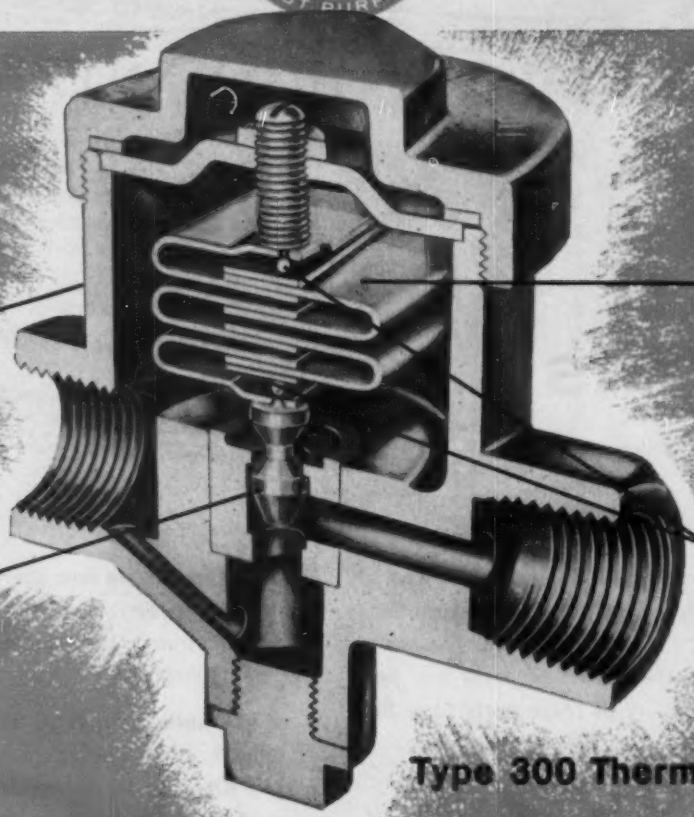
CONICAL NON-SEGREGATING COAL DISTRIBUTORS

COAL SCALES
Two Basic Sizes

COAL VALVES
6" to 60" – Many Styles

ONLY Farris MIL

PROGRESS THROUGH HONEST PURPOSE



FORGED MANGANESE BRONZE BODIES

Standard trap bodies (except the float models) are forged manganese bronze, selected for long life on steam. Aluminum bronze bodies also available.

HAND LAPPED PRESSURE BALANCED VALVES

Every Farris Mil valve is individually hand lapped to seat perfectly on the stainless steel insert. Valves are unaffected by pressure changes, respond only to temperature change.

INDESTRUCTIBLE BI-METAL

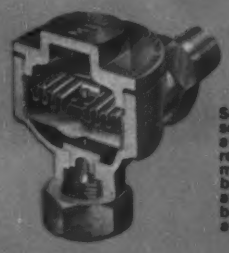
All Farris Mil trap bi-metallic thermal elements are high quality stainless steel. Cannot be damaged by water hammer, frost or corrosion. 2° sensitivity.

FRICTION-FREE FLOATING UNIVERSAL JOINTS

Bi-metallic element and valve cannot hang up or jam—no friction—no wear—no corrosion—no wire drawing—no maintenance.

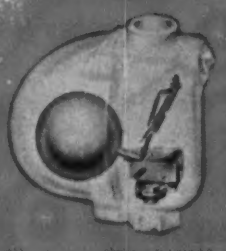
Type 300 Thermostatic

3 MODELS . . . 9 TYPES



SELF-ADJUSTING THERMOSTATIC

Self-Adjusting models are factory set to release water and air from a steam system as well as to release condensate at a predetermined temperature. Available in 4 body patterns in 25 psi, 65 psi and 125 psi ratings, forged bronze bodies, stainless steel element and valve, aluminum bronze seat.



FLOAT THERMOSTATIC

Float type Farris traps provide rapid high capacity venting of air and cold condensate at start-up. Unique rocker design gives high mechanical advantage. Body is hi-tensile iron, all mechanical parts stainless steel. Available in 75 psi and 180 psi ratings.

EFFICIENT TRAPPING DEPENDS ON THERMAL CHANGE! SAVE WITH MIL THERMOSTATIC TRAPS FOR ALL PLANT-WIDE SERVICE

SEND FOR NEW CATALOG

Free 8 page Farris Mil trap catalog #PE-310 gives complete dimensional data, performance information, and capacities for all 9 types.

Manufactured under patents, patents pending and licenses of Midland Industries Ltd., the largest producer of thermostatic steam traps in Europe.

Farris **ENGINEERING CORP.**

MIL DIVISION

627 COMMERCIAL AVENUE • PALISADES PARK, N. J.

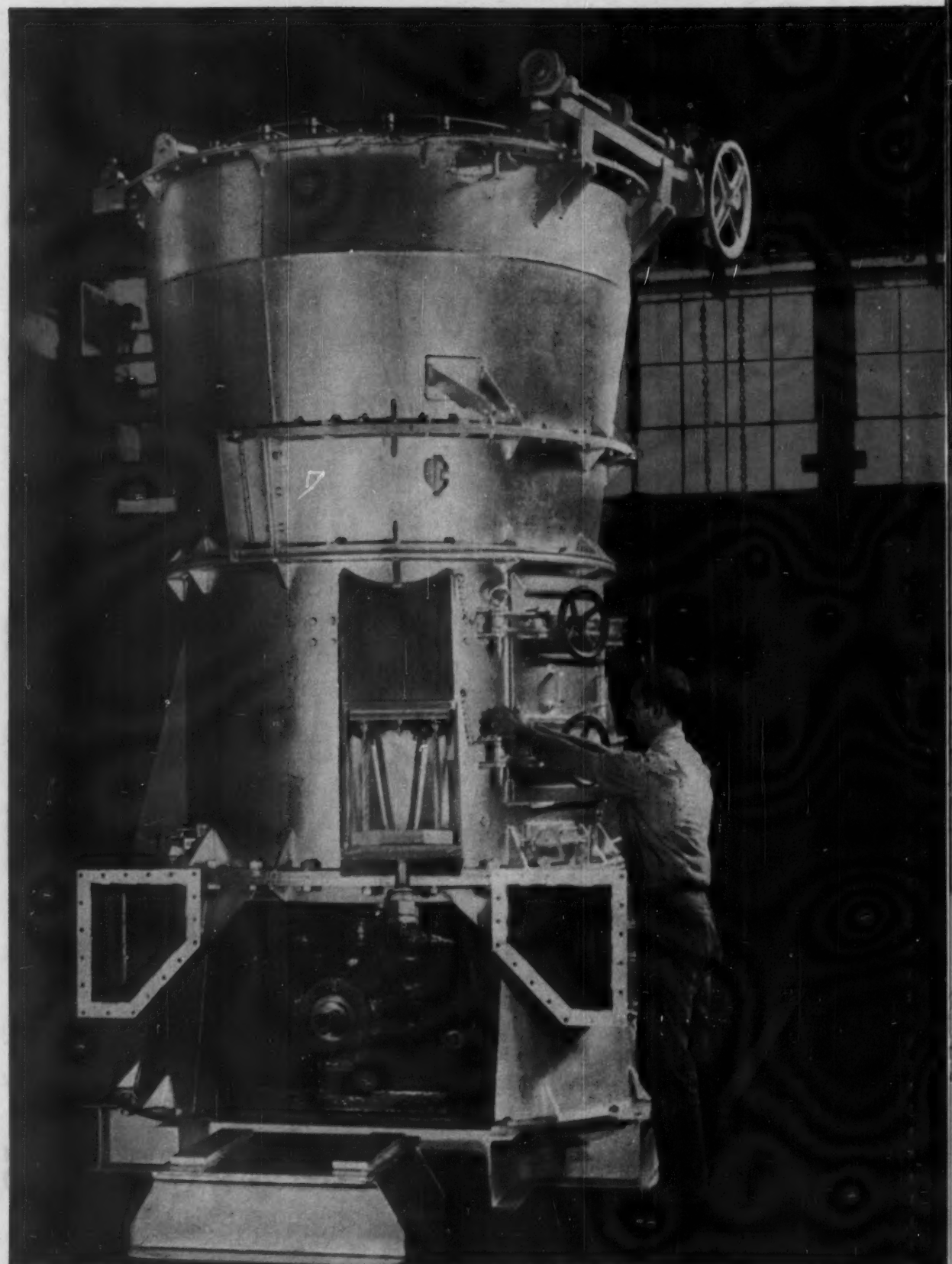
AFFILIATES:

Farris Flexible Valve Corp. • Farris Engineering Ltd., London, England • Farris Universal Machine Corp. • Farris Combustion Controls Corp. • Midland Industries Ltd., Wolverhampton, England

STEAM TRAPS

are indestructible ■ will not wire draw ■ will not freeze up ■ cannot be damaged by water hammer ■ do not need a cooling leg ■ cannot corrode ■ operate instantaneously ■ are pressure balanced ■ have full floating, friction free, self aligning, stainless steel valves ■ cost less ■ are guaranteed two years

OVER A MILLION IN USE! TRY US—SEND YOUR ORDER FOR ONE OR MORE TRAPS. YOUR MONEY BACK IF THEY DO NOT PERFORM AS STATED!



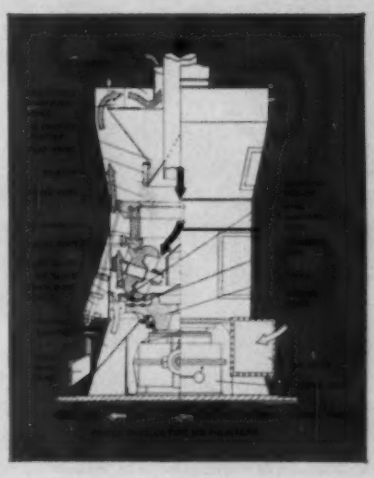
Foster Wheeler MB planetary roll and table pulverizer. Available with capacities from 2 ton/hr to 55 ton/hr.

Foster Wheeler MB Pulverizer, SIMPLE...VERSATILE...RELIABLE

The best combination of advantages for a wide range of fuel requirements

COMPARISON: Foster Wheeler MB pulverizer compared with two other leading pulverizers (A & B) available in U.S.

Power consumption	equal to A & B
Availability	better than A, equal to B
Accessibility	better than A & B
Floor Space	equal to A & B
Flexibility for suction or pressure operation	equal to A, better than B



European power companies have used the MB pulverizer for over 10 years. Low power consumption, low maintenance and the extremely high availability of the design are thoroughly proven.

Now further refined by FW engineers, and tested for two years in the U.S., the MB pulverizer deserves careful consideration in planning any fuel system which may require mill capacities from 2 to 55 tons of pulverized fuel per hour.

The MB design is extremely simple, providing reliability and ease of maintenance. The only moving parts inside the grinding area are three spheroidal rollers, a roller guide, and the powered horizontal grinding table. All adjustments can be made with the mill in operation.

The planetary motion of the rollers maintains uniform product fineness. Wear of grinding surfaces is extremely slow. The rollers and carrier need no lubrication. Noise and vibration levels are very low.

Provision is made for either pressurized or suction operation. In addition to coal pulverizing, the MB mill is also available for grinding gypsum, cement, solid chemicals, pigments, food products and other commercial materials.

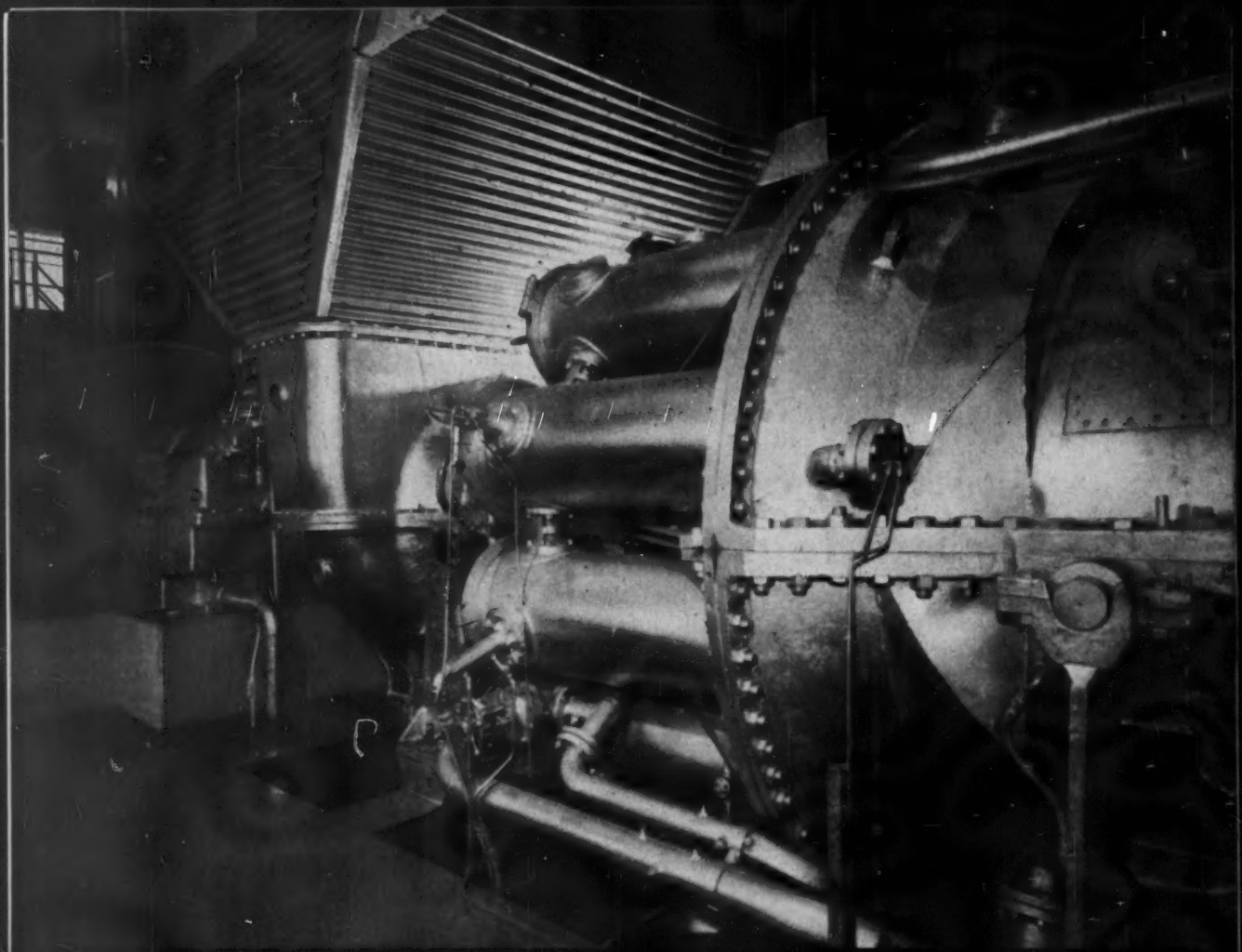
Write for Bulletin MB-58-1, giving more detailed specifications for the MB mill. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.

For more facts circle 788 on Reader Service card, p 207

Circle 789 on Reader Service card for following ad ➤



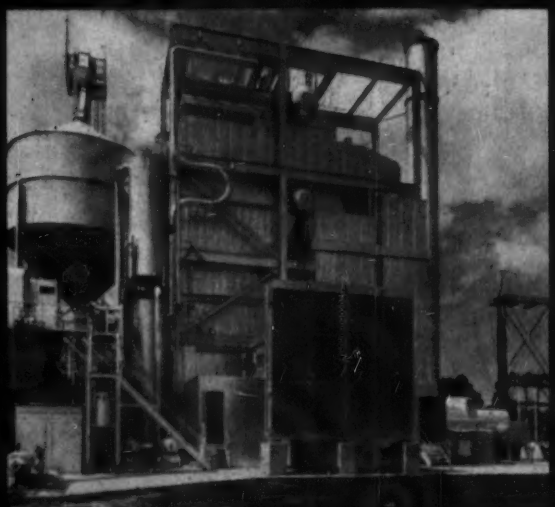
PEAK LOAD CAPACITY is being provided by General Electric gas turbines like this 10,000-kw unit with demonstrated record of starting, operating reliability.

This General Electric gas turbine experience record can assure you of reliability for your '61 peak loads:

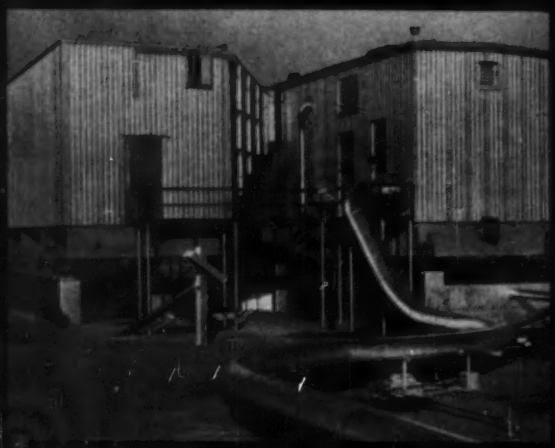
200 operating gas turbines
1,200,000 installed kilowatts*
4,000,000 hours, or
450 machine-years of operation

General Electric Turbine-Generators Help Keep Power Costs Low

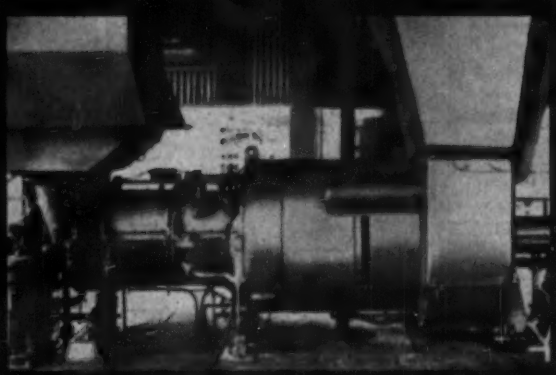
Large steam turbine-generators for base load 100,000 kw and up



PLANT EFFICIENCY IMPROVED more than six percent over a conventional steam station with this 5,000-kw gas turbine operating in the first combined gas-steam turbine utility plant.



ON THE ARABIAN DESERT, six unattended pipeline pumping stations powered by reliable General Electric gas turbines are being radio-controlled from fifty to one hundred miles away.



IN A PROCESS CHEMICAL PLANT, this G-E gas turbine operated continuously for 13,178 hours, or nearly 18 months, before maintenance requirements of process equipment dictated a shutdown.

FOUR YEARS OF PEAK-LOAD SERVICE crammed into each month — that's the equivalent in peak load service of these General Electric gas turbine-electric locomotives which start 400 times each month.

You can apply General Electric gas turbines to peaking service with assurance of reliable performance. The highlights of the unequalled General Electric gas turbine experience record are reflected in the figures above.

Additional proof of reliability includes these facts:

- thirty-two General Electric gas turbines have operated over 230,000 hours in electric utility applications including peaking, end-of-line, and base-load service;
- a study of all General Electric gas turbines in high-use-factor service (50 units) reveals an average of 98% availability and 99.5% reliability with many of the units having been in service since the early 1950's; and
- ten units are now in service with over 50,000 hours of operation, 35 units with over 40,000 hours and 64 units with over 30,000 operating hours.

And these remarkable records have been set under some of the most severe operating conditions—some of which are shown in these illustrations.

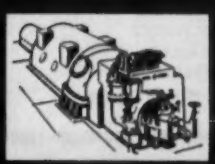
Reliable General Electric gas turbines—available in a wide range of sizes—are the *economical* answer to your peak generation needs.

FOR INFORMATION about the application of General Electric peak load gas turbines on your system, call the G-E sales engineer in your area, or write for Bulletin GED-3761. General Electric Company, Schenectady 5, New York. 247-40

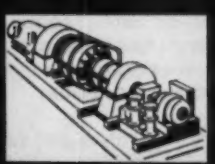
*Equivalent KW

Progress Is Our Most Important Product

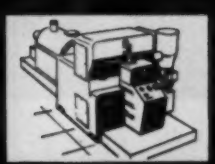
GENERAL ELECTRIC



Medium steam turbine-generators for base load — 100,000 Kw and down



Gas turbines for peaking, combined steam-gas cycle, and base load



Mechanical drive steam turbines for boiler feed pumps and other auxiliaries

WHERE DO YOU STAND ON BOILER

TYPICAL USERS OF YARWAY INDICATORS FROM OVER 15,000 INSTALLATIONS

INDUSTRIAL PLANTS

WEYERHAEUSER COMPANY
REPUBLIC STEEL CORP.
FORD MOTOR COMPANY
UNION BAG & PAPER COMPANY
WESTINGHOUSE ELECTRIC CORP.
GENERAL ELECTRIC COMPANY
STAUFFER CHEMICAL COMPANY
WILSON & COMPANY
U. S. STEEL COMPANY
GENERAL MOTORS
MOBIL OIL COMPANY

UTILITIES

(Code Case #1155 Installations)

COMMONWEALTH EDISON
IOWA ILLINOIS GAS & ELECTRIC
CENTRAL ILLINOIS PUBLIC SERVICE
ILLINOIS POWER CO.
WISCONSIN POWER & LIGHT
LAKE SUPERIOR DISTRICT POWER
NORTHERN STATES POWER CO.
PUBLIC SERVICE OF INDIANA
INDIANAPOLIS POWER & LIGHT
IOWA ELECTRIC LIGHT & POWER
NEBRASKA POWER
NEW ENGLAND POWER
ROCHESTER GAS & ELECTRIC CO.
PENNSYLVANIA ELECTRIC CO. (ERIE, PA.)
OMAHA PUBLIC SERVICE
CENTRAL ILLINOIS ELECTRIC
NARRAGANSETT ELECTRIC CO
LOUISIANA POWER & LIGHT
HARTFORD ELECTRIC LIGHT CO.
POTOMAC ELECTRIC POWER CO.

WATER LEVEL INDICATION ?

YARWAY REMOTE INDICATORS HAVE BRILLIANT "WIDE ANGLE" VISIBILITY... CAN BE INSTANTLY READ FROM MULTIPLE VANTAGE POINTS

Yarway Remote Liquid Level Indicators bring distant, often hard-to-see boiler level readings right down to eye level on the panel board or other convenient location.

No matter where you stand—at any point in a 180° arc, and from a considerable distance—the brilliant new wide vision dial makes viewing and reading easy.

GIVE INSTANT, ACCURATE READINGS BECAUSE INDICATOR IS OPERATED BY THE BOILER WATER ITSELF

Remote readings of levels in boilers (also feed water heaters and other heat exchangers) are instant and accurate because indicator *operating mechanism* is actuated by the varying head of the liquid itself, yet the *pointer mechanism* is never under pressure.

Constant pressure from a controlled-temperature constant head chamber located above drum level is maintained on one side of diaphragm (1) in indicator. Varying pressure changing with water level is maintained on opposite side of diaphragm. Change in differential between the two pressures moves the diaphragm which in turn regulates, through deflection plate (2), magnet (3), and spiral magnetic armature (4), the position of the counterbalanced pointer (5).

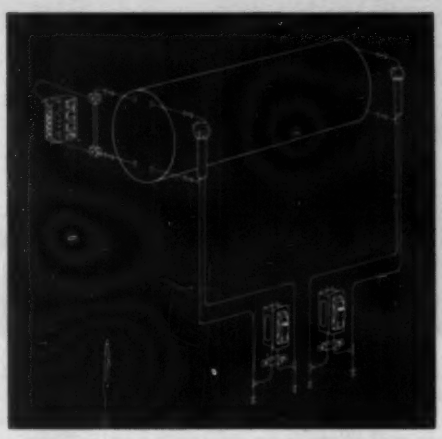
OPERATE ADDITIONAL REMOTE SIGNAL ALARMS, HORNS OR LIGHTS

With the addition of a control unit Yarway Indicators may be equipped to operate auxiliary hi-lo signal alarms, horns or lights located at any place in the plant. Electronic secondary indicators may also be used to duplicate readings at remote points.

FULLY APPROVED AS PRIMARY INDICATING ELEMENTS UNDER BOILER CODE CASE #1155

Under A.S.M.E. Boiler Code Committee ruling in Case #1155, two independent remote level indicators of compensated manometric type may be used instead of one of two required gage glasses for boiler pressures 900 psi and above. When both indicators are in operation, the gage glass may be shut off but shall be maintained in serviceable condition.

Yarway Remote Liquid Level Indicators conform to this ruling and are used widely for primary boiler water level indication in plants operating at 900 psi and above.



All Yarway Indicators for service over 700 psi are temperature-compensated; pressure compensation available when desired. Use of controlled-temperature column on constant head chamber fully protects against system upsets.

If you would like a reprint of this Boiler Code ruling, just ask for Case #1155 reprint.

Get the full story on Yarway Liquid Level Indication for your plant. Write for new 24-page Bulletin WG-1825.

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

A MARK OF QUALITY IN STEAM ENGINEERING

For more facts circle 790 on Reader Service card, p 270

SAVINGS up to 20% on CONVEYOR COSTS
12 to 60% GREATER HAULING CAPACITY

...possible with

RAY-MAN CONVEYOR BELT

It's a mathematical certainty that a belt can haul bigger loads with 45° idlers than with regular 20° idlers. But the 45° angle between concentrating idlers and bottom roll idlers is too sharp for an ordinary heavy duty conveyor belt. Plies separate, but modern RAY-MAN CONVEYOR BELT licks this problem . . . for all time!

Ray-Man's exclusive flexible construction and built-in stress compensation are guaranteed to take the sharp angle of 45° idlers without ply or cover separation at the hinge line. This opens a whole new era of conveyor design . . . permitting larger loads . . . narrower conveyors . . . assuring longer cover wear . . . lower handling costs!

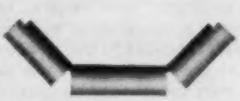
Ask your R/M representative to show you how Ray-Man Conveyor Belt with 45° idlers can give you the most for your conveyor dollar . . . write for new Bulletin M303, "Ray-Man for 45° Idlers."

RAY-MAN BELT IS BUILT TO TAKE THE EXTRA STRESS OF 45° IDLERS

BIGGER LOADS, LESS SPILLAGE, LESS WEAR ON COVER WITH 45° IDLERS

20° IDLERS REQUIRE WIDER CONVEYOR TO HAUL SAME TONNAGE

ORDINARY PLY BELTS ARE TOO BOARDY TO TAKE 45° IDLERS

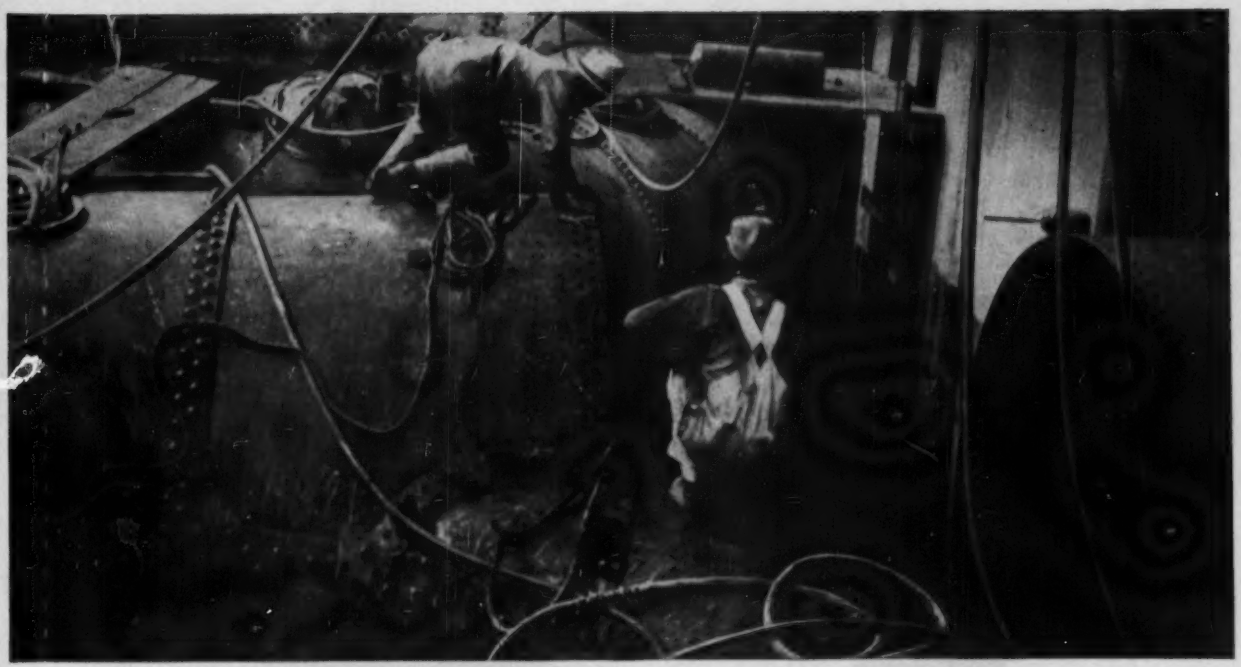


RAY-MAN IS GUARANTEED NOT TO PLY-SEPARATE AT 45° ANGLES

RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

RM

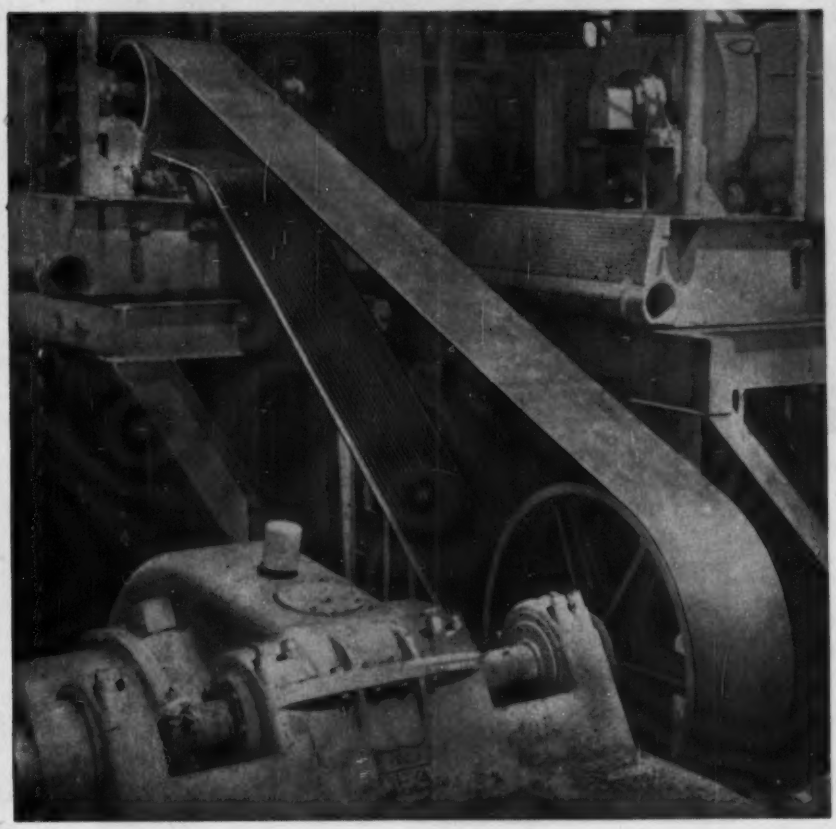
ENGINEERED RUBBER PRODUCTS ..."MORE USE PER DOLLAR"



HOMOFLEX HOSE IS MORE FLEXIBLE, WEIGHS LESS THAN ANY HOSE FOR EQUAL PRESSURE

- FLEXIBLE AS A ROPE
- SUPER-STRONG
- NO PRE-SET TWIST—WILL NOT KINK
- UNIFORM INSIDE & OUTSIDE DIAMETERS
- INSEPARABLE TUBE-TO-COVER BOND
- EASIER, SAFER COUPLING
- FASTER, FULLER FLOW
- "MORE USE PER DOLLAR"

Let your R/M Distributor show you the advantages of Homoflex for air, water, other fluid and gases; also other types of R/M rubber hose for your job applications. Write for Bulletins M610 and M694.



CONVERT TO R/M POLY-V® DRIVE FOR MORE POWER IN LESS SPACE... *with Reliability*

- SINGLE UNIT V-RIBBED DESIGN—flat belts are also single units
- ELIMINATES BELT "MATCHING" PROBLEMS
- MAINTAINS GROOVE SHAPE
- CONSTANT PITCH AND SPEED RATIOS
- LESS WEAR ON BELT AND SHEAVES
- COMPLETE CONTACT-PRESSURE

Just two Poly-V belt cross sections meet every heavy duty power transmission requirement.

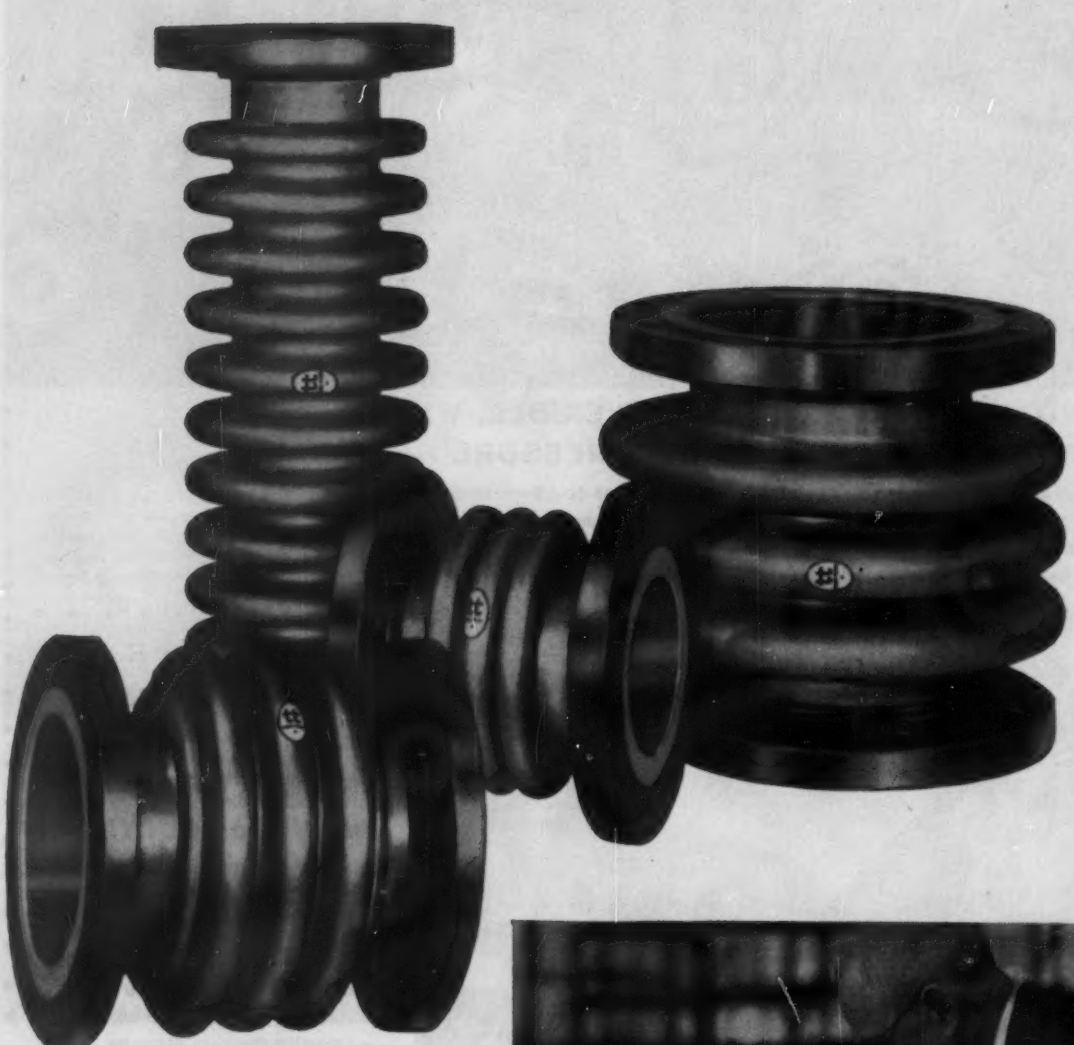
R/M Poly-V* Drive is the smoothest and coolest running —*longest wearing* drive you can install. Discuss your application with an R/M Distributor . . . or write for Poly-V* Drive Bulletin M141.

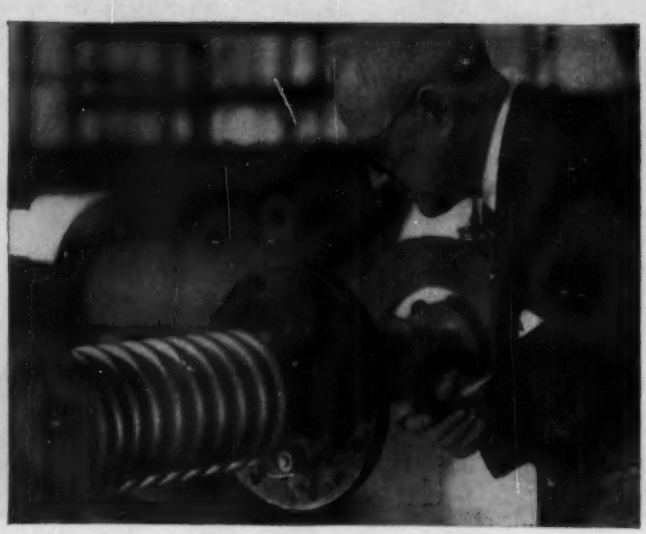
**Poly-V is patented by Raybestos-Manhattan, Inc.*

RM-1031

For more facts circle 791 on Reader Service card, p 207

NEW...FROM





TUBE-TURN *Bellows Expansion Joints are test rated on basis of minimum cyclic life.*

TUBE TURNS...

Bellows Expansion Joints test rated for assured cyclic life

Tube Turns has introduced a brand new concept in bellows expansion joints to fill a vital need in engineered piping systems.

These new bellows joints are rated on the basis of thorough, well organized test studies to *assure a definite minimum cyclic life*... rather than the usual average or maximum. This conservative rating, backed by Tube Turns' extensive test results, gives you an assurance of *confidence* heretofore lacking in the application of bellows joints.

Hence, you can specify TUBE-TURN* Bellows Expansion Joints and be sure of predictable performance. These top-quality products will be subject to the same warranties that apply to all other products of Tube Turns.

Backed by Tube Turns' technical service! This new line of products is backed by 31 years of pioneering research in piping technology, including problems of piping flexibility. Our sales-engineering representatives, located nearby, will assist in the application of TUBE-TURN Bellows Expansion Joints to your specific problems.

Complete line. TUBE-TURN Bellows Expansion Joints are available in sizes 3" through 30"... unreinforced, are rated as high as 75 psi in sizes 12" and smaller... reinforced, are rated as high as 400 psi, in sizes 8" and smaller. Adjusted pressure temperature ratings have been established for the full size range up to 800°F. Also, expansion compensators for steam and hot water service are available in sizes ¾" through 2". Mail coupon for complete information.

*The trademarks "TUBE-TURN" and "tt" are applicable only to the quality products of Tube Turns.

Another tt *plus value from...*

TUBE TURNS

DIVISION OF CHEMETRON CORPORATION
Louisville 1, Kentucky

CHEMETRON

DISTRICT OFFICES: Atlanta • Buffalo • Chicago • Columbus • Dallas Denver • Detroit • Houston • Kansas City • Los Angeles • New York Philadelphia • Pittsburgh • Richmond • St. Petersburg • San Francisco • Seattle Shreveport • Tulsa

In Canada: TUBE TURNS OF CANADA LIMITED, Ridgetown, Ontario
District Offices: Edmonton • Montreal • Toronto

In Mexico: TUBE TURNS DE MEXICO, Mexico City

MAIL FOR CATALOG. Lists available sizes of TUBE-TURN Bellows Expansion Joints... includes rating tables to guide in piping design. Mail coupon for free copy.

TUBE TURNS, Dept. PO-10
224 E. Broadway • Louisville 1, Kentucky

Send catalog on TUBE-TURN Bellows Expansion Joints.

Company Name _____

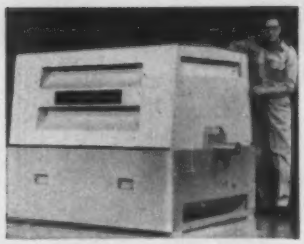
Company Address _____

City _____ *Zone* ____ *State* _____

Your Name _____

Position _____

For more facts circle 792 on Reader Service card, p 207



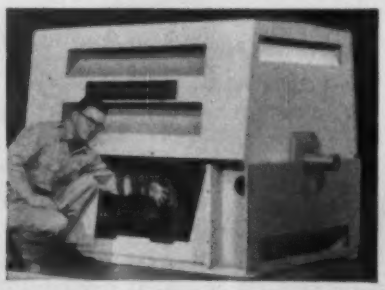
MORE VALUE FOR YOUR LARGE MOTOR INVESTMENT . . .

how Westinghouse F/A Motor design

What's new in inspection procedures for large motors? Less of it . . . up to 75% in both time and dollars directly chargeable to this chore.

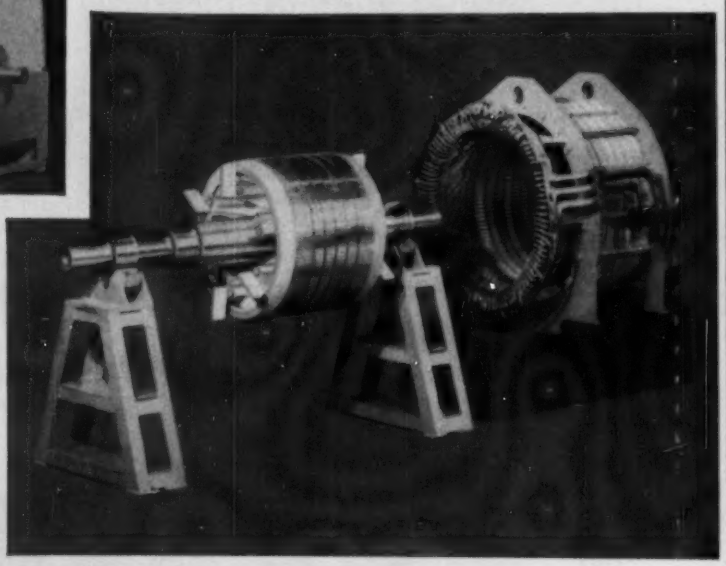
The reason Westinghouse can offer such unusual savings in inspection and maintenance is the revolutionary new F/A Motor design. For the first time, here is full accessibility coupled with the time-tested and -proved reliability of Westinghouse motor components. The motor housing is completely separate from the stator and can be removed in minutes for thorough visual inspection.

This degree of accessibility is impossible with conventional motors. As a consequence, the F/A Motor can be more thoroughly inspected and maintained, thus guaranteeing true value

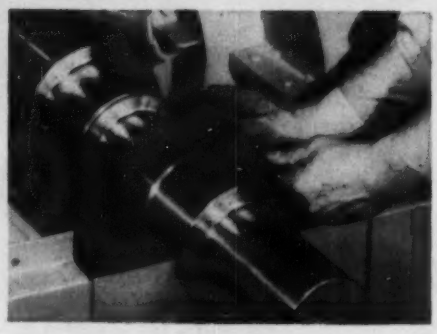


Inspection of leads and connections is simple. There are no protruding conduit boxes; cable comes up through the base, leaving plenty of room for connecting motor leads.

Disassembly as complete as this is impossible in conventional motors. With the Westinghouse F/A Motor it *can* be done, and in only 90 minutes. Reassembly takes only 2 hours, for a total of 3½ hours for a complete dismantling.



For routine inspection of windings and bearings, simply remove the end panels (above). **For complete bearing inspection,** merely remove bearing cap, top bearing shell and oil ring; then bottom bearing shell rolls out for easy inspection (right). **For more thorough inspection,** end covers, panels and air shields can be removed in only 38 minutes and replaced in 56—with the motor still in running condition!



YOU CAN BE SURE...IF IT'S

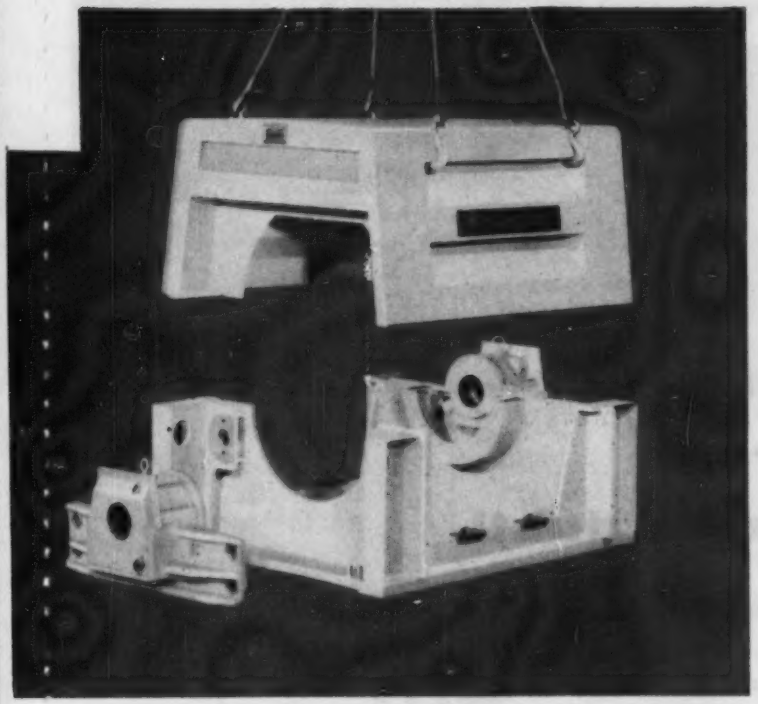
cuts inspection time and costs as much as 75%

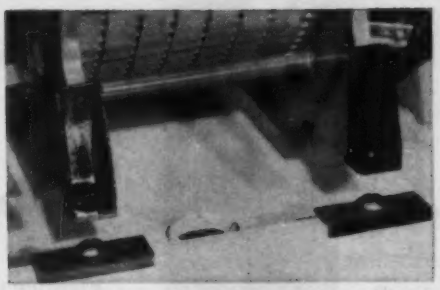
and long life for your large motor investment. Speedier work saves up to 75% of the man-hours and money usually expended in these procedures. Outages, too, are fewer and shorter.

In addition, these bonus values are yours in the F/A Motor—Thermalastic® insulation, with super-reliability proved in over 50 million kw of Westinghouse large rotating apparatus since its development 11 years ago; extra quietness, virtually eliminating the shrill screech of the typical large motor.

You'll want more information on this most modern of all large motors. Call your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-15016





Special ball-and-socket type locator joints simplify removal and replacement of stator in annual inspections. In reassembly, perfect realignment is automatic.

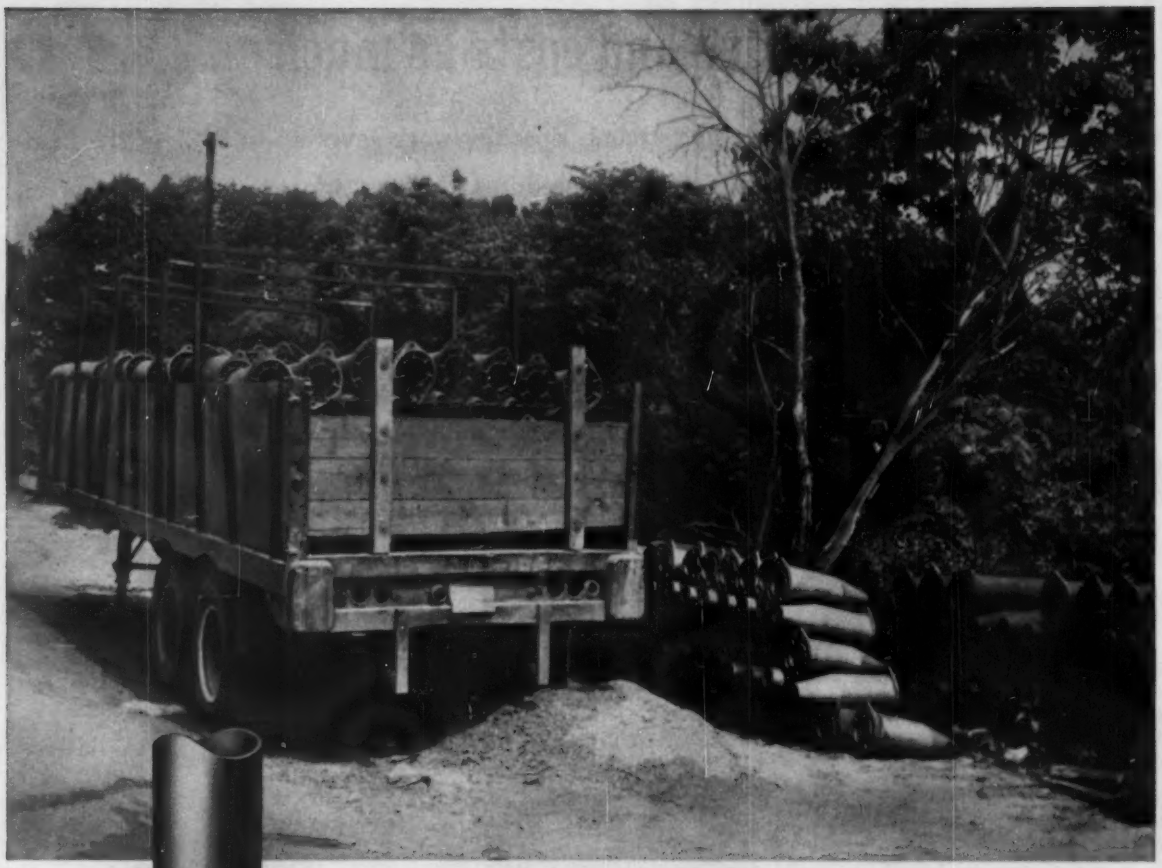
COMPARE! How much time are you spending on large motor inspections?

USE THIS SIMPLE CHART TO MAKE YOUR OWN COMPARISON TESTS!

INSPECTION OPERATION	TIME—F/A MOTORS	TIME—YOUR MOTORS
Routine: Including windings, bearings and leads.	Removal of panels and shields—38 min. Replacement—56 min.	
Annual: Including complete teardown.	Disassembly—90 min. Reassembly—120 min.	

Westinghouse

For more facts circle 793 on Reader Service card, p 207



TYPE
C10
CYCLO-TRELL

Ammunition for the war on dust!

Fighting dust is the purpose of this load of Cyclo-trell C10 "shells." ■ Cyclo-trell units for process gas or air cleaning in steel mills, refineries, paper, cement or chemical plants give you high efficiencies. ■ Engineered to fit each specific job, Cyclo-trell units are available in a wide range of sizes and types including C10, C24, IC (Involute Cyclo-trell) and ICL (Involute Cyclo-trell, Lined). ■ Why not let us consult with you on your specific dust collection problems? For further information, write for Bulletin 300 which describes several applications in detail.

Research-Cottrell

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, N. J.
Representatives in principal cities of U.S. and Canada

COTTRELL
TRADE MARK
RC-809

For more facts circle 794 on Reader Service card, p 207

SIX CENTRIFUGAL PUMPS VOTED "BEST VALUE" FOR THE 60's

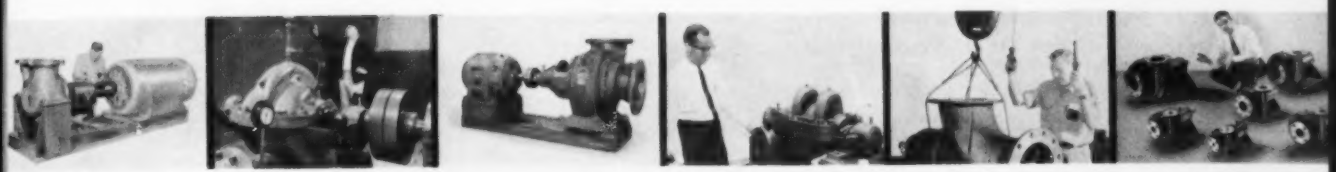
"Every salesman has his favorite product." And so do Worthington Technical Representatives. By vote they picked the six centrifugal pumps that were their "favorites"—preferred because they felt these Worthington pumps give you the most value for your pump dollar.

Remember, this value rating has been awarded by Worthington Technical Representatives on the basis of their observations of your operating needs. See the booklet below for a summary of the features that make each of these six pumps your best buy.

6 FOR THE 60's

Six Worthington centrifugal pump lines selected by Worthington Technical Representatives as giving the most value to their customers.

WORTHINGTON



6 for the 60's Pump Information Guide

The ideal product combination of economical design and efficient performance requires programs in many areas—Research, Engineering, Manufacturing—are only a few. Knowledge gained by Worthington in these areas is used to improve pump design and is made available to pump users as well.

Worthington projects making this knowledge available have taken many forms. For example:

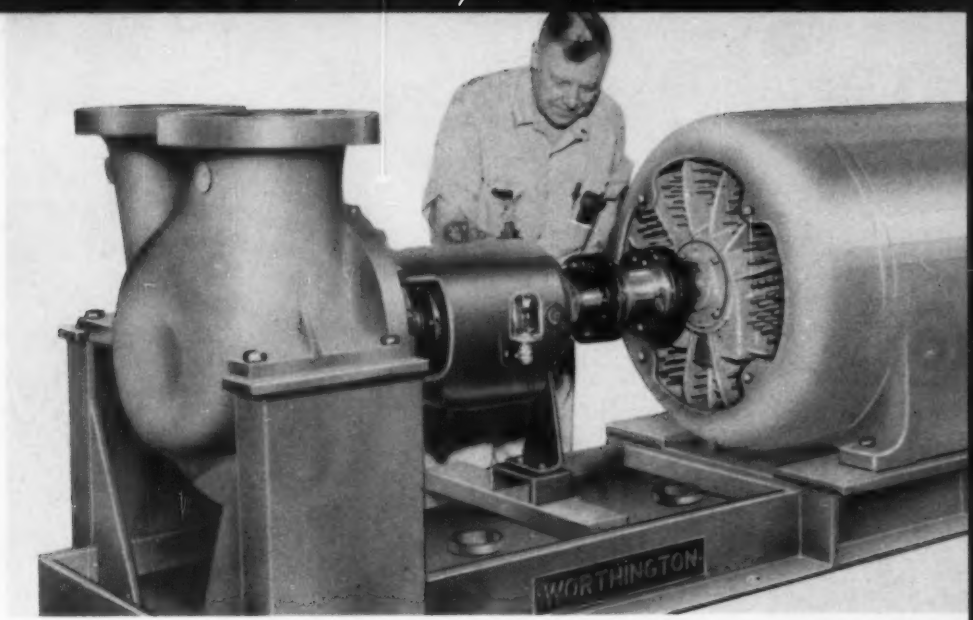
Technical Pump Seminars—currently being conducted with customers throughout the country.

The Centrifugal Pump Clinic—presented in the form of questions and answers in the interests of better pump operation.

Reprints of Technical Articles—detailed discussions of pump application and design topics. Two typical releases are "An experimental investigation of radial thrust in centrifugal pumps" (RP-1087) and "Cavitation and NPSH" (RP-1094). These two papers represent extensive research at Worthington's Harrison, New Jersey Research Laboratory.

Your Worthington Technical Representative will be glad to discuss your pumping problems and provide information on the above programs—call him at your local Worthington District office.

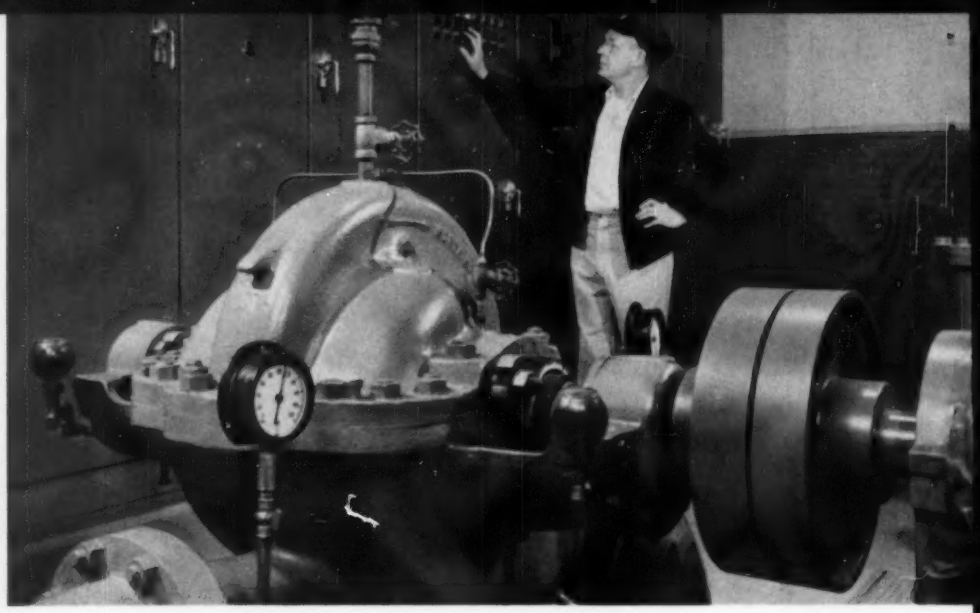
HN



MOST ECONOMICAL FOR PROCESS JOBS—REQUIRE LESS NPSH

Worthington HN pumps offer remarkably low NPSH requirements. Construction features are outstanding, too. For example, the positive ring oil lubrication system and bearing housing protected against contamination assure long trouble-free service. And the large diameter cantilever shaft assures negligible deflection, thus prolonging wearing ring, seal or packing and sleeve life. Built for flexibility and interchangeability, HN pumps handle temperatures to 850F and pressures to 600 psi.

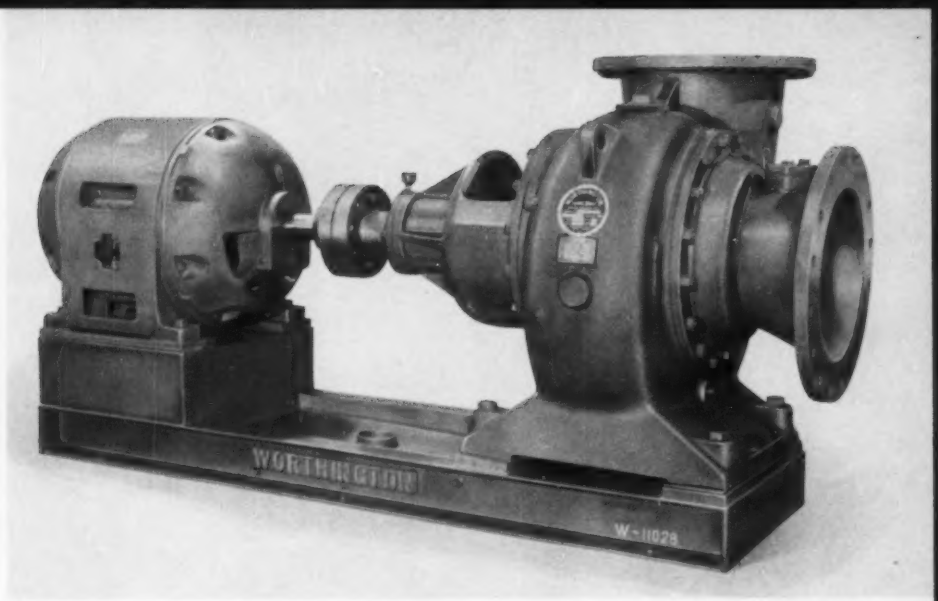
LN



"DOUBLE VOLUTE" DESIGN IS RADIALLY BALANCED AT ANY LOAD

These general purpose pumps use a casing design that gives hydraulic balance at any capacity. This design, called "Double Volute," makes pump operation possible from design point back to shut-off without adverse effects of hydraulic radial reaction. "Double Volute" design reduces wear and makes an LN pump one of the most reliable you can buy. And just as important, the LN design includes many other up-to-date features for economical installation and operation.

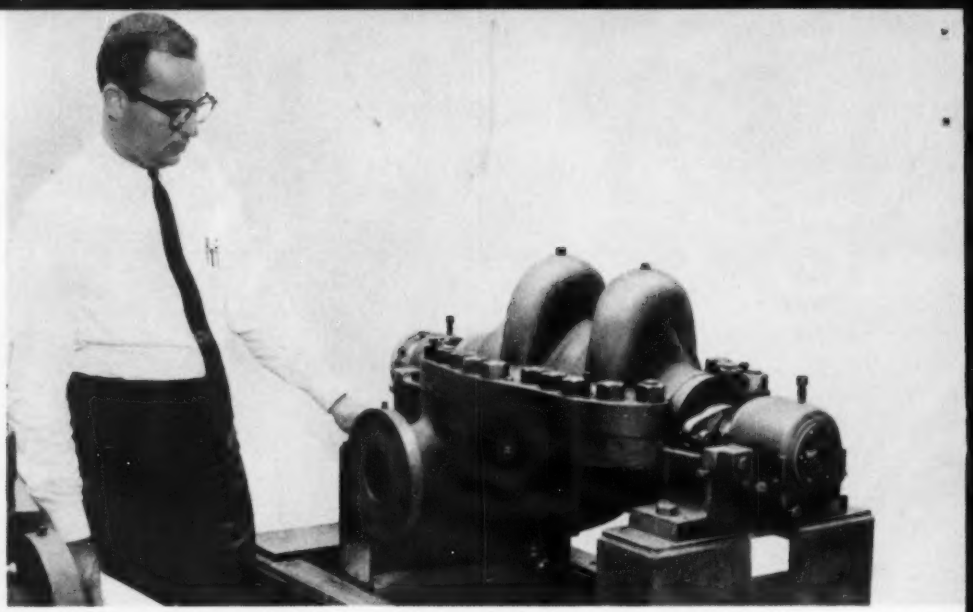
MC



HIGH CAPACITY AT LOW HEADS—WITHOUT CLOGGING

Type MC is the Worthington Mixflo pump—proven for irrigation, drainage, waste disposal, condenser circulating and low-head water supply. Non-clogging sewage type closed impellers pass large solids. There are variations in construction to suit any installation: bronze or chrome steel wearing rings; bronze or chrome steel shaft sleeve; vertical bottom suction models, discharge in any direction too. Sizes 10″ to 84″.

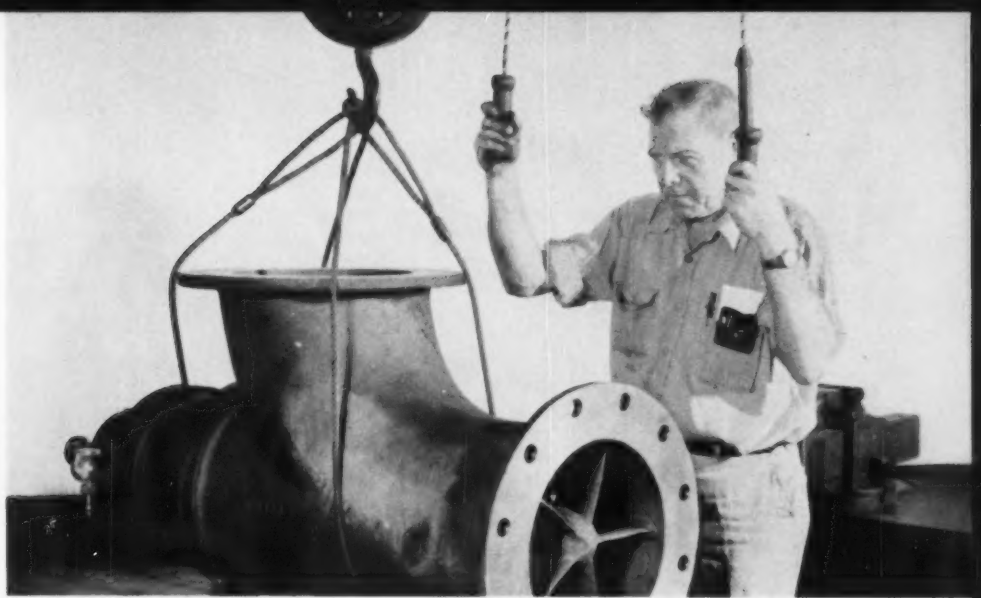
UN



A RUGGED, HEAVY-DUTY PUMP AT A COMPETITIVE PRICE

Any reputable manufacturer can build a pump that will outlast anything on the market. The trick is to do it at a competitive price, with proven design features. This dual ideal has been accomplished with Worthington's UNB and UNQ pumps through a planned program of standardized parts and simplified manufacturing techniques. Typical of the outstanding design features is the elastic seal ring that prolongs casing life by eliminating interstage leakage.

KB



AN ELBOW PUMP WITH APPLICATION AND INSTALLATION FLEXIBILITY

Worthington's KB elbow pumps have been designed to provide an economical combination of operating efficiency and NPSH requirements. The construction lends itself to installation in place of an elbow in a circulating system. Designed with top suction to reduce installation cost. KB elbow pumps are supplied in Type 300 stainless steels and Worthite—Worthington's super stainless.

SE-
SC

STANDARDIZATION TO CUT INVENTORY AND MAINTENANCE

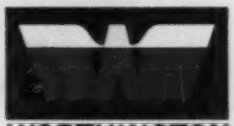
This Worthington Standard End Suction Centrifugal line takes care of about 70% of all centrifugal pump requirements, as proven by sales records showing basic types of pumps purchased. Ratings range up to 2700 GPM and 230 ft. head. In each of 120 pump ratings, there's a variety of materials of construction, types of liquid ends, shaft sealing methods and drives. There are literally 70,480 combinations to choose from—but the extreme standardization can cut warehousing and inventory costs as much as 50% and reduce maintenance.

SIX CENTRIFUGAL PUMPS VOTED "BEST VALUE" FOR THE 60's

"Every salesman has his favorite product." And so do Worthington Technical Representatives. By vote they picked the six centrifugal pumps that were their "favorites"—preferred because they felt these Worthington pumps give you the most value for your pump dollar.

Remember, this value rating has been awarded by Worthington Technical Representatives on the basis of their observations of your operating needs. See the booklet below for a summary of the features that make each of these six pumps your best buy.

P.S. In an election like this some had to lose. Actually, picking the winners was tough . . . the Worthington pump line covers virtually every pumping job well. Tell us your problem . . . we'll gladly give you a recommendation based on an unbiased complete line selection.



WORTHINGTON

"6 for the 60's" Pump Information Aids

WORTHINGTON CORPORATION
Section 21-5
Harrison, New Jersey

Please send me application and performance data on the lines checked below:

HN_____ MC_____ KB_____

LN_____ UN_____ SESC_____

NAME_____

COMPANY_____

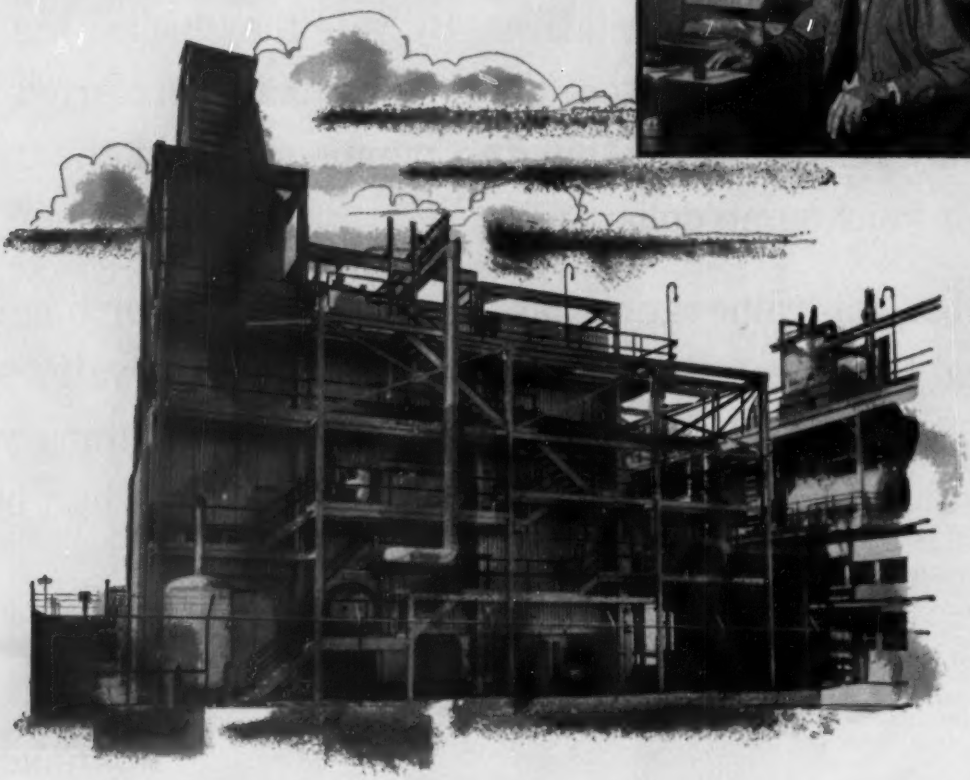
STREET_____

CITY_____ STATE_____

NEW WICKES STEAM GENERATOR

insures maximum efficiency and dependability for BRYAN, TEXAS, MUNICIPAL POWER PLANT

Calvin W. Beard, Superintendent of the Electric Utilities of Bryan, Texas, Municipal System: "As in every other power plant, our steam generator must give completely dependable performance day in and day out".



This Wickes Type RB 2 drum boiler is designed to produce 220,000 lbs. of steam per hour at 875 psig and 900° total steam temperature for the city of Bryan, Texas. The unit performs not only with remarkable dependability, but with Wickes' usual efficiency and economy. Wickes Boiler Co. builds steam generators in sizes to 500,000 lbs. of steam per hour, for high or low steam pressures and temperatures and for all types of fuels and firing methods. See your nearest Wickes representative for full information on a Wickes steam generator designed to suit your needs.

WICKES

RECOGNIZED QUALITY SINCE 1854

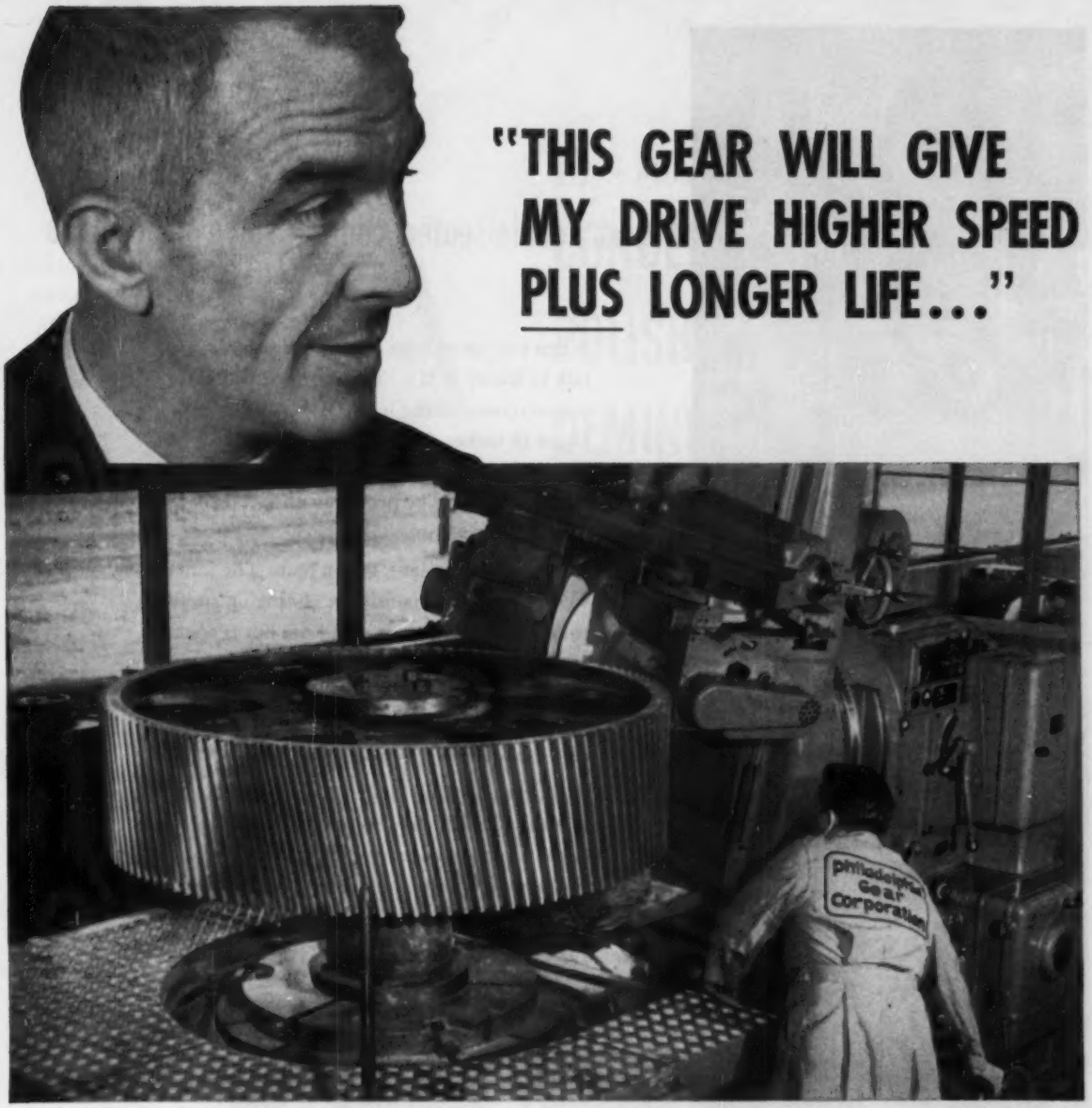
Sales Offices: Atlanta • Boston • Charlotte, N.C. • Chicago • Cleveland Dallas • Denver • Detroit • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New Orleans • New York City • Philadelphia • Portland, Ore. • Rochester, N.Y. • Saginaw • San Francisco • Seattle, Wash. Springfield, Ill. • Tulsa

Bulletin 55-1 gives details of a wide variety of designs and sizes of Wickes field-erected and shop-assembled steam generators. Write for your free copy.

174

WICKES BOILER CO., SAGINAW 10, MICHIGAN, DIVISION OF THE WICKES CORPORATION

For more facts circle 796 on Reader Service card, p 207



"THIS GEAR WILL GIVE MY DRIVE HIGHER SPEED PLUS LONGER LIFE..."

Utilizing the modern facilities in our newly equipped plant, higher speed and longer life are just two of the advantages that you will get with Philadelphia's revolutionary precision grinding technique. Very often these advantages are available at no more initial cost than conventional gearing.

HIGHER SPEEDS

Dynamic load factors are materially reduced. Your equipment can operate at higher speeds with increased load carrying capacity.

LONGER LIFE

Extreme accuracy of profiles, profile spacing and surface finish eliminates "running-in" periods and resulting wear.

REDUCED NOISE AND VIBRATION

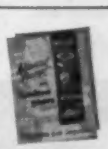
Reduced tooth to tooth errors, accumulated pitch errors, and total composite errors give smoother contact . . . reduce noise and vibration.

REDUCED BACKLASH

Precision ground gearing means reduced backlash for reversing drives . . . plus uniform backlash where precision of movement is important.

100% INTERCHANGEABILITY

Duplicate units or spares can be installed with original manufacturing tolerances duplicated exactly.



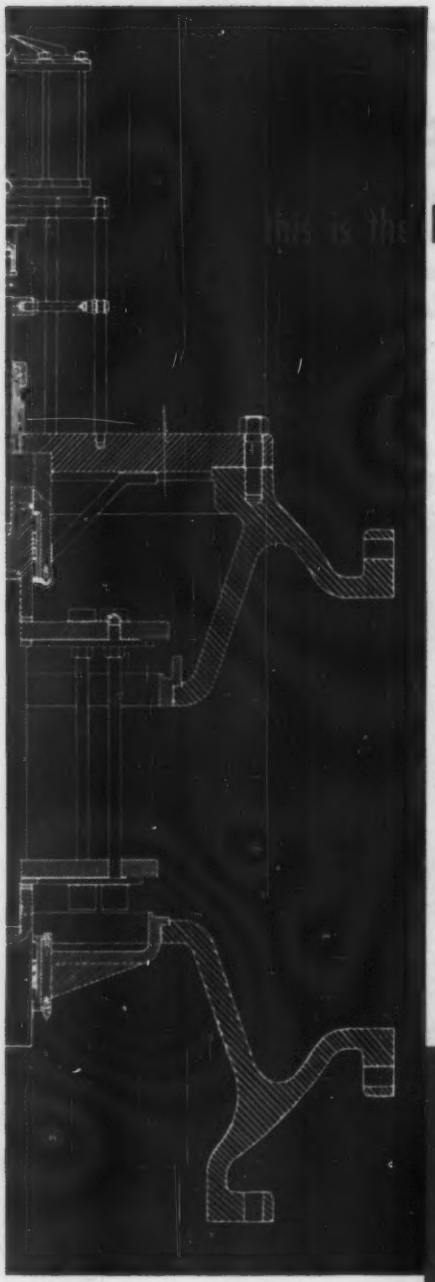
FOR MORE INFORMATION

. . . investigate this modern technique. Send for our new bulletin, AN ADVANCED CONCEPT IN MODERN GEARS.

PHILADELPHIA GEAR CORPORATION

King of Prussia (Suburban Philadelphia), Pennsylvania

For more facts circle 797 on Reader Service card, p 207



this is the largest double-seated control valve ever made

When you are talking *big* control valves, talk to Kieley & Mueller. K&M is the largest manufacturer of the big ones, control valves above 16 inches. Standard globe-type valves are available in 20, 24, 30 and 36 inch sizes; even larger valves will be produced on special order.

This 36-inch double-seated angle valve closes snugly on giant Teflon seats. The inner valve positions responsively, gliding on special roller-slide bearings. It's massive, but is operates protected by a K&M patented torque resistor. Beyond the problem of size, this valve is mounted on its side, and it has been performing creditably for over four years.

BIG or small, if it's control valves, you'll like the pitch-in, helpful approach of your local K&M representative . . . plus capable engineering and manufacturing follow-thru at the K&M plant.

Write for Bulletin CV-53.

ABOVE: Partial cross-section of K&M 36-inch valve showing general construction.

AT RIGHT: Actual size of a 36 inch valve can be visualized from this illustration of a workman inside the valve body performing finishing operations.

K&M

KIELEY & MUELLER, INC.

78th Anniversary . . . Oldest U.S. Pressure and Level Control Valve Manufacturer

For more facts circle 949 on Reader Service card, p 207

High Flow Rate

CONDENSATE POLISHING DEMINERALIZERS

With External Regeneration Without Prefilters

Properly designed condensate polishing demineralizers without prefilters *can* handle the high suspended iron and copper loads encountered during initial boiler startup.

The first large scale (3200 g.p.m.), high flow rate, externally regenerated, condensate demineralizer without filters operated satisfactorily during initial plant startup. It has continued to produce excellent feedwater during post-startup operation without replacement of the original resin charge.

Three more plants of similar design are now under construction.

INFILCO

INFILCO INC.

General Offices—Tucson, Arizona

Field offices throughout the United States and in other countries. 451-60

For more facts circle 950 on Reader Service card, p 207

Circle 951 on Reader Service card for following ad ➤

COMMONWEALTH EDISON COMPANY
Chicago, Illinois
COLUMBUS & SOUTHERN OHIO ELECTRIC COMPANY
Columbus, Ohio
CENTRAL POWER & LIGHT COMPANY
Corpus Christi, Texas
CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
Springfield, Illinois
DALLAS POWER & LIGHT COMPANY
Dallas, Texas
CONNECTICUT LIGHT & POWER COMPANY
Berlin, Connecticut
DELAWARE POWER & LIGHT COMPANY
Delaware City, Delaware
CONSUMERS POWER COMPANY
Jackson, Michigan
CINCINNATI GAS & ELECTRIC COMPANY
Cincinnati, Ohio
EL PASO ELECTRIC COMPANY
El Paso, Texas
FLORIDA POWER CORPORATION
St. Petersburg, Florida
LONG ISLAND LIGHTING COMPANY
Long Island, New York
HOUSTON LIGHTING & POWER COMPANY
Houston, Texas
KANSAS GAS & ELECTRIC COMPANY
Wichita, Kansas
MISSISSIPPI POWER COMPANY
Gulfport, Mississippi
OHIO EDISON COMPANY
Akron, Ohio
OKLAHOMA GAS & ELECTRIC COMPANY
Oklahoma City, Oklahoma
NIAGARA MOHAWK POWER CORPORATION
Syracuse, New York
PUBLIC SERVICE COMPANY OF NEW MEXICO
Albuquerque, New Mexico
ROCKLAND LIGHT & POWER COMPANY
Nyack, New York
PENNSYLVANIA ELECTRIC COMPANY
Johnstown, Pennsylvania
PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
Manchester, New Hampshire
SAN DIEGO GAS & ELECTRIC COMPANY
San Diego, California
TEXAS ELECTRIC SERVICE COMPANY
Ft. Worth, Texas
PUBLIC SERVICE COMPANY OF OKLAHOMA
Tulsa, Oklahoma
SOUTHERN CALIFORNIA EDISON COMPANY
Los Angeles, California
SOUTHERN ELECTRIC GENERATING COMPANY
Birmingham, Alabama
SOUTHWESTERN GAS & ELECTRIC COMPANY
Shreveport, Louisiana
TEXAS POWER & LIGHT COMPANY
Dallas, Texas

CAROLINA POWER & LIGHT COMPANY
Raleigh, North Carolina

CALIFORNIA ELECTRIC POWER COMPANY
Riverside, California

ARKANSAS POWER & LIGHT COMPANY
Little Rock, Arkansas

ALABAMA POWER COMPANY
Birmingham, Alabama

GEORGIA POWER COMPANY
Atlanta, Georgia

ATLANTIC CITY ELECTRIC COMPANY
Atlantic City, New Jersey

ARIZONA PUBLIC SERVICE COMPANY
Phoenix, Arizona

IN ORBIT with PACIFIC...

This galaxy of steam power generating plants produces a substantial portion of America's electrical output on an uninterrupted round-the-clock basis year after year. Pacific Boiler Feed Pumps are also delivering uninterrupted service within the stations of this impressive constellation of electrical power generating companies.

Send for your copy of the Pacific Type BFI Centrifugal Boiler Feed Pump Bulletin 122A.

PACIFIC PUMPS
Inc. . . A Division of Dresser Industries, Inc.
HUNTINGTON PARK, CALIFORNIA

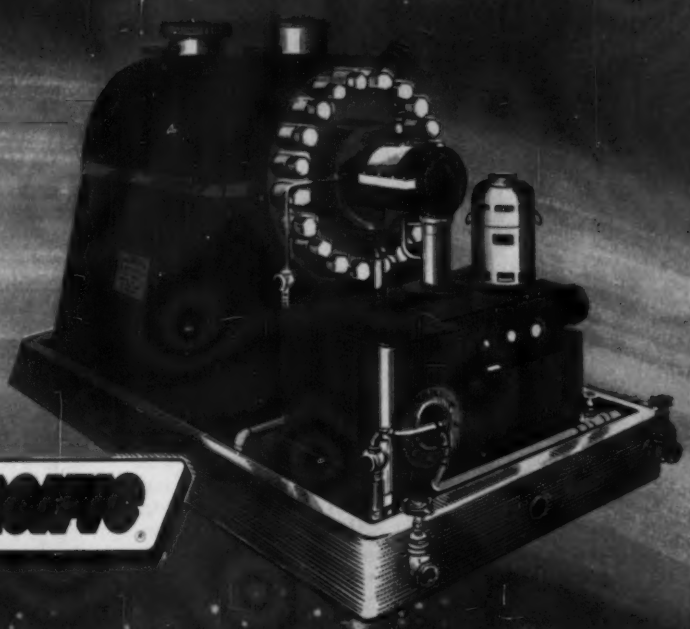
UTAH POWER & LIGHT COMPANY
Salt Lake City, Utah

MEMPHIS LIGHT, GAS & WATER DIVISION
Memphis, Tenn.

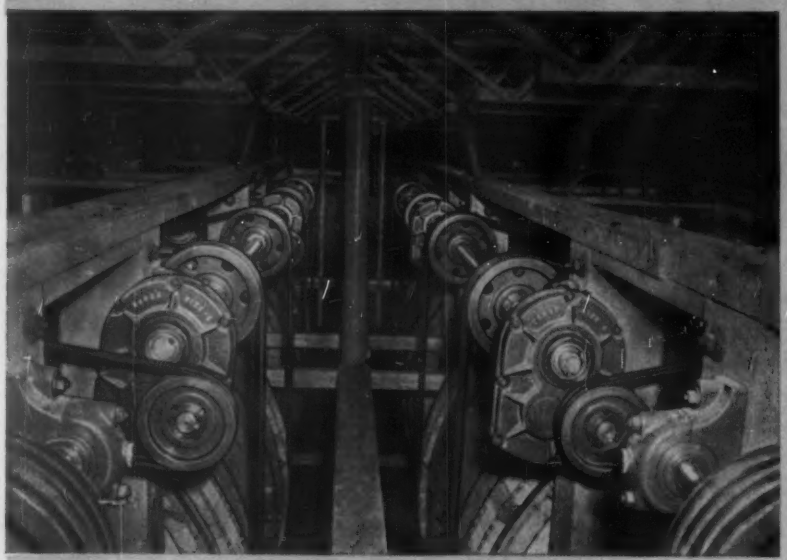
UNITED ILLUMINATING COMPANY
New Haven, Connecticut

. . . AND MANY OTHERS

TUCSON GAS, ELECTRIC LIGHT & POWER COMPANY
Tucson, Arizona

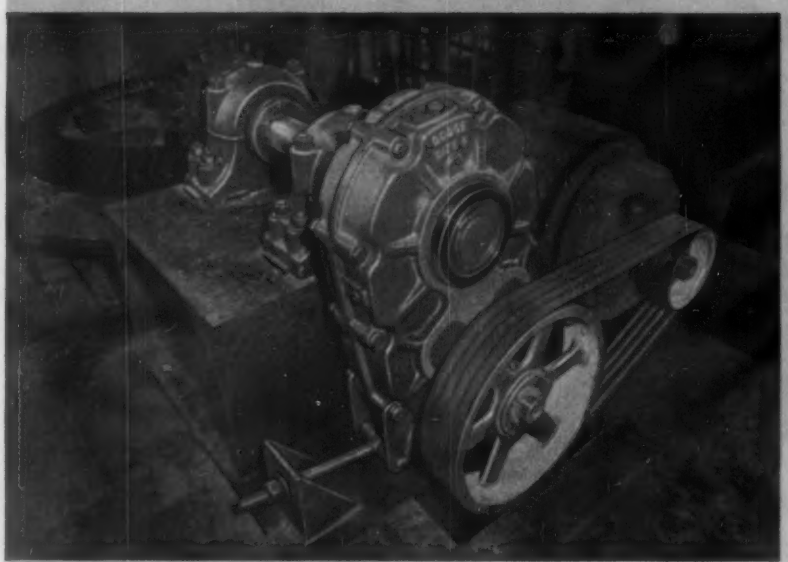


PACIFIC



DODGE TORQUE-ARM SHAFT MOUNTED SPEED REDUCER

Install it anywhere—with minimum time and effort. Here is an overhead installation on tanning drums. Torque-Arm reducers are resistant to acid fumes, salt water environment, moisture.



DODGE TORQUE-ARM SHAFT MOUNTED SPEED REDUCER

Can be positioned any place on the entire length of the shaft. It locks into place on *both* sides of the housing. Note modified torque arm on this installation on a mixer in a beverage plant.

The Speed Reducer Idea that

Two things account for the record popularity of Dodge Torque-Arm Speed Reducers. First, they cost less to install since they require no foundations, sliding motor rails or flexible couplings. Second—and most important—these modern reducers as developed by Dodge perform *brilliantly*. Tens of thousands of installations underscore Torque-Arm dependability. Torque-Arm is America's *quality* shaft mounted speed reducer!

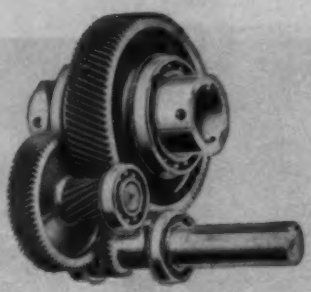
Torque-Arm has been so extensively adopted by industry that today models are available for a vast range of applications. The Torque-Arm line offers you capacities up to 170 hp—output speeds from 10 to 400 rpm—in single and double reduction series—with 5 to 1, 15 to 1 and 25 to 1 ratios. Models for vertical or inclined shaft operation are available—as well as special-application versions such as flange mounted, right

Rugged semisteel housing— a solid backbone for solid service

Here is a tough, corrosion-resistant housing with the strength to hold bearing seats in line for the life of the unit. Perfect shaft and gear alignment are assured by doweling the matched halves together and boring in line. No gear is overhung. Loads are carried easily, contributing to Torque-Arm's long life and high efficiency—97% in double reduction models, almost 99% in single!

AGMA rated gears— quality-guarded by continual tests

These helical gears have soft cores to withstand shock—and hardened surfaces to resist wear. Their quality is guarded in manufacture and assembly by the most modern methods of quality control, including inspection for runout, tooth spacing, helical lead and involute profile. They run quietly, mesh precisely. Teeth are crown shaved for maximum contact area. Gears are shrunk on their shafts to prevent shifting.



Modern double-lip seals keep oil in and dirt out

Modern synthetic, double-lip seals of the highest quality keep oil in and dirt out of the reducer case. These seals offer protection for the unit from dust and dirt and just as effectively insure cleanliness when operating in laundries, textile mills, food processing plants.

Re-ally Clicked!

angle and extended input shaft styles. Optional equipment includes a positive, sealed-in backstop and a positive overload release.

Ask your local Dodge Distributor. Or write us for our 64-page Torque-Arm Speed Reducer Bulletin, complete with engineering data and easy selection tables.

DODGE MANUFACTURING CORPORATION
3200 Union Street • Mishawaka, Indiana

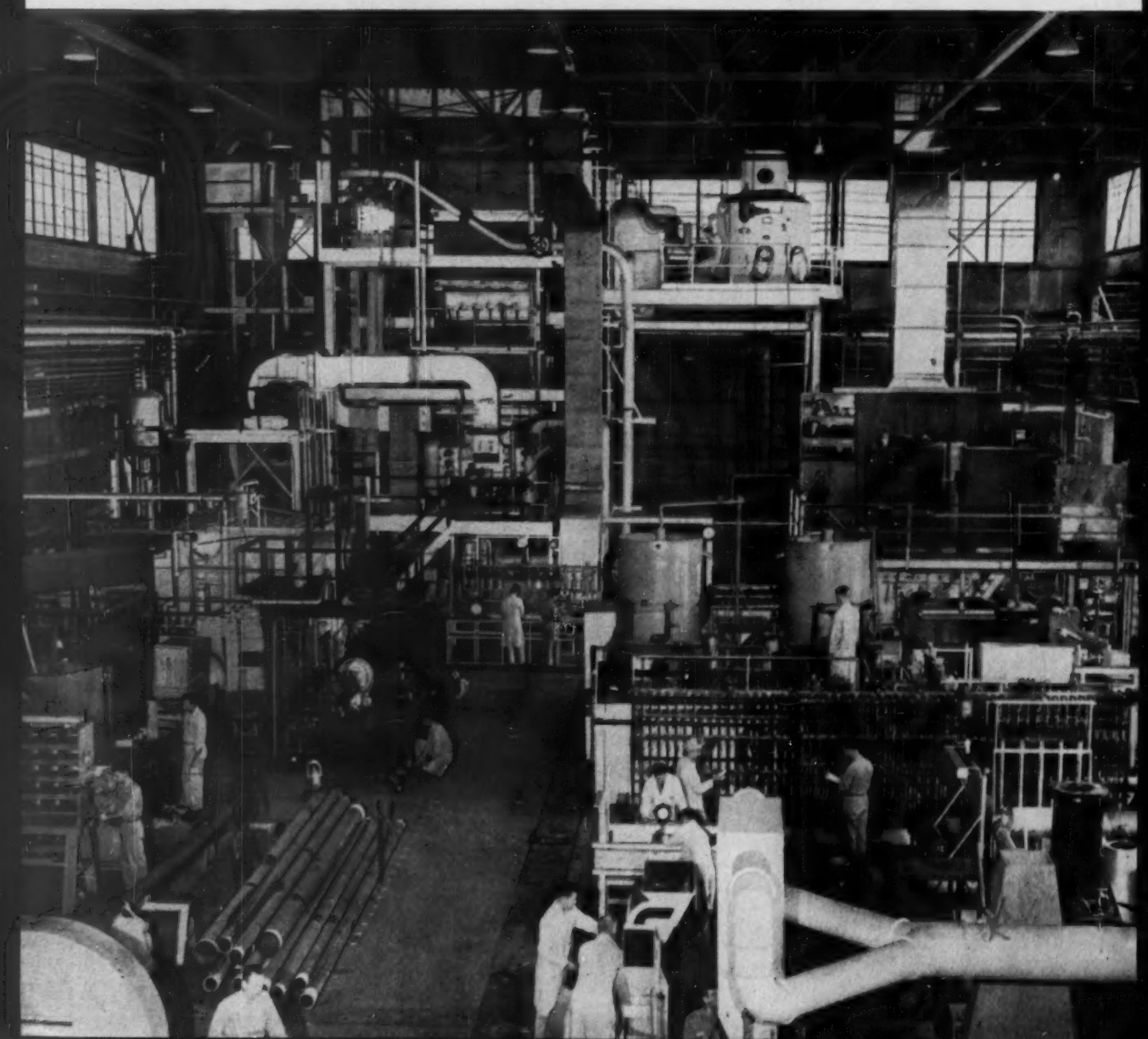
DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery."

For more facts circle 801 on Reader Service card, p 207

C-E MEASURES THE MERITS OF IDEAS

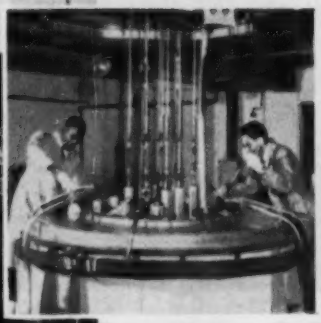
At Combustion, research guides the design of every product and is at the hub of every area of operation. It is a company policy, the premiums of which are paid for in the time and talents of many skilled and experienced specialists. Their purpose—to find a better way. Their goal—to enable Combustion to provide the most efficient, the most reliable and the most economical steam generating and fuel burning equipment available anywhere.



...WITH RESEARCH

Research activities at C-E range from studies of the nuclear characteristics of the atom and the combustion of fossil fuels to the development of methods and materials, the test of metals and the operation of test boilers and nuclear reactor systems. Research, knowledgeable and in depth, is your assurance that C-E products are thoroughly engineered, are dependable and are as modern as tomorrow.

THE KREISINGER DEVELOPMENT LABORATORY is used for the study of fuels and fuel burning systems, water, steam and combustion gases. It contains several test boilers, among them a large Controlled Circulation unit capable of operating at 2000 pounds pressure and a super-critical pressure boiler designed to produce steam at 5000 pounds pressure and 1200°F. This laboratory is one of eight C-E research facilities which, together, total more than four acres under roof.



THIS ADVANCED CRITICAL FACILITY is one of two zero power nuclear reactors used by Combustion for test and experimentation.

THIS CHEMISTRY LABORATORY uses a battery of test furnaces to study the causes and effects of corrosive substances in combustion gases.

THIS PHOTOELASTIC LABORATORY makes plastic models of various kinds of pressure vessels and loads them to simulate actual operating conditions. Using straining frames and polariscopes, it analyzes the stress patterns locked in the plastic to determine suitability of design.

THIS METALLURGY LABORATORY tests material strength at high temperatures with these creep-rupture machines.

THE COMPUTER CENTER is used for many kinds of research work. C-E utilizes both digital and analog computer systems.

COMBUSTION ENGINEERING

General Offices: Windsor, Conn. • New York Offices: 200 Madison Ave., New York 16 C-281A

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE.

For more facts circle 802 on Reader Service card, p 207

*Controls for a 1,260,000 lb/hr boiler are housed on a 36" wide console**

Centralized control space-saver

... the POWRMAG REMOTE CONTROL STATION

Easy to operate, and featuring front mounting and removal, the PowrMag Remote Control Station is ideal for the compact consoles demanded by centralized control. Here are some of the facts on PowrMag:

FULL STATION—size 2¼" x 5¼". As shown above, contains set point, bias or ratio dial, manual/automatic switch, manual control dial, output signal and null indicators.

HALF STATION—size 2¼" x 3⅛". With set point, bias or ratio dial, plus output signal indicator.

BUMPLESS TRANSFER—Simple adjustment of null-indicator provides bumpless transfer from Manual to Automatic or back. No operator memory is required. Output signal indicator shows valve or other control element position.

FRONT MOUNTING AND REMOVAL—Makes unit easy to check or change. AN-type connector, and 12-wire color coded cable makes it easy to interconnect system.

The complete system includes PowrMag Control Units and PowrMag Patchboards. Control units consist of operational magnetic amplifiers together with interchangeable reset, rate and other circuit packages to perform all control functions. Patchboards interconnect the system in any desired manner—no solder connections or terminal boards—all connections are made by special taper pins.

A letter or phone call will bring you more information on reliable, space-saving PowrMag. **Ask for Bulletin MSP-163.**

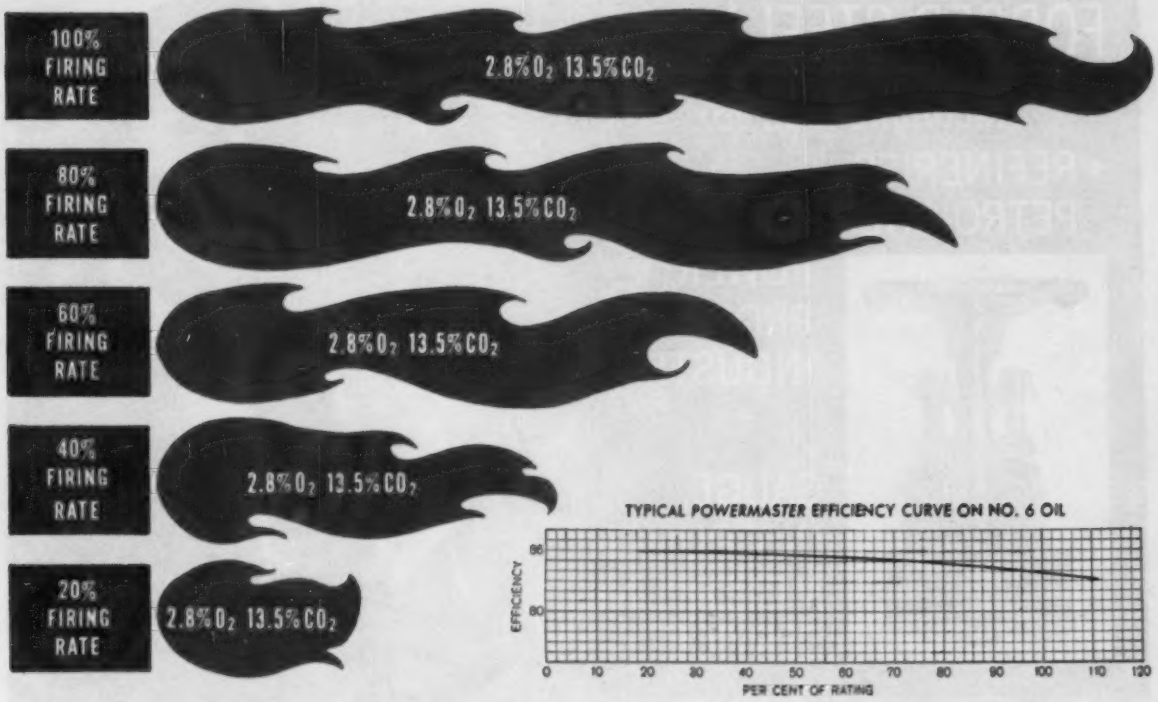
*Name on request

HAGAN
CHEMICALS & CONTROLS, INC.
HAGAN CENTER, PITTSBURGH 30, PA.

HAGAN DIVISIONS: CALGON CO. • HALL LABORATORIES • BRUNER CORP.

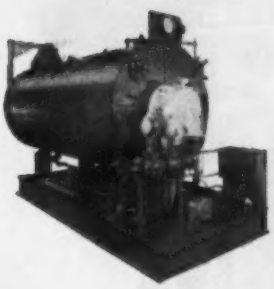
For more facts circle 803 on Reader Service card, p 207

FROM THE WORLD LEADER IN PACKAGED AUTOMATIC BOILERS AND BURNERS



Only *Powermaster*® gives you this type efficiency

Constant fuel-air ratio assures maximum efficiency at any load . . . cuts operating costs . . . returns investment faster



Whether you operate a *Powermaster* boiler from a low of 20% to a high of 100% of capacity, you get the same high constant efficiency. With O&S exclusive 5 to 1 turndown, fuel-air ratio is maintained at all loads with the same low percentage of excess air (2.8% O_2) and high percentage of CO_2 (13.5%).

This constant efficiency is important to you for three reasons: 1. Lower operating costs; 2. faster return on your investment; 3. more uniform heating, more uniform process and improved product quality.

Whether your requirements are for comfort heating, process or power, you'll pay for your boiler investment faster with an O&S *Powermaster*. For information on all *Powermaster* benefits, call your nearest O&S representative or write for Bulletin 1260.

75th Anniversary

ORR & SEMBOWER, INC.
850 Morgantown Road
Reading, Pa. • Since 1885

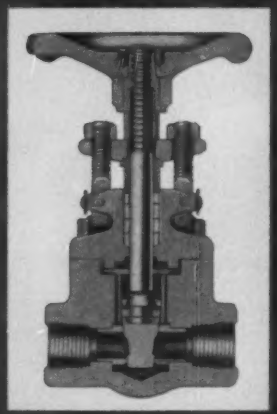
Powermaster®
PACKAGED AUTOMATIC BOILERS

For more facts circle 804 on Reader Service card, p 207

FORGED STEEL VALVES

Recommended for:

- REFINERIES, PETRO-CHEMICAL, POWER, PROCESS INDUSTRIES
- GAUGE, INSTRUMENT, METER LINE SERVICE



"R-P&C Forged Steel Valves are designed for streamlined safety"

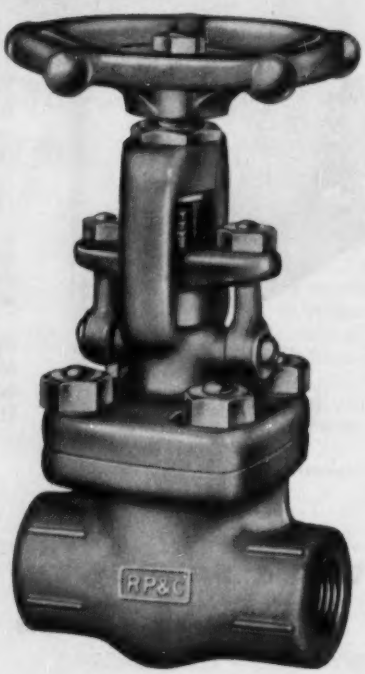
"'Streamlined safety' is the R-P&C way of saying that this Forged Steel Valve is now lower in weight yet higher in safety than ever before. Thanks to an improved design worked out with leading material specification engineers, all unnecessary bulk and weight in R-P&C Forged Steel Valves have been eliminated. **Ample metal sections** throughout the valve body still give it the highest possible safety factor."

Other new design features like these add up to a long life of trouble-free service:

- **Spiral wound gasket in bolted bonnet joint**
- **Careful heat treatment of parts for strength and wear**
- **Unique stem design to protect stuffing box packing**
- **High quality materials to prevent corrosion**
- **Precision manufacture with exacting standards**

In addition to these Forged Steel Gate and/or Globe Valves, R-P&C distributors offer users in all industries a complete line of R-P&C gate, globe and angle valves in all standard materials: electric furnace iron, bronze, bar stock, cast steel...plus many specialties.

Contact your R-P&C distributor



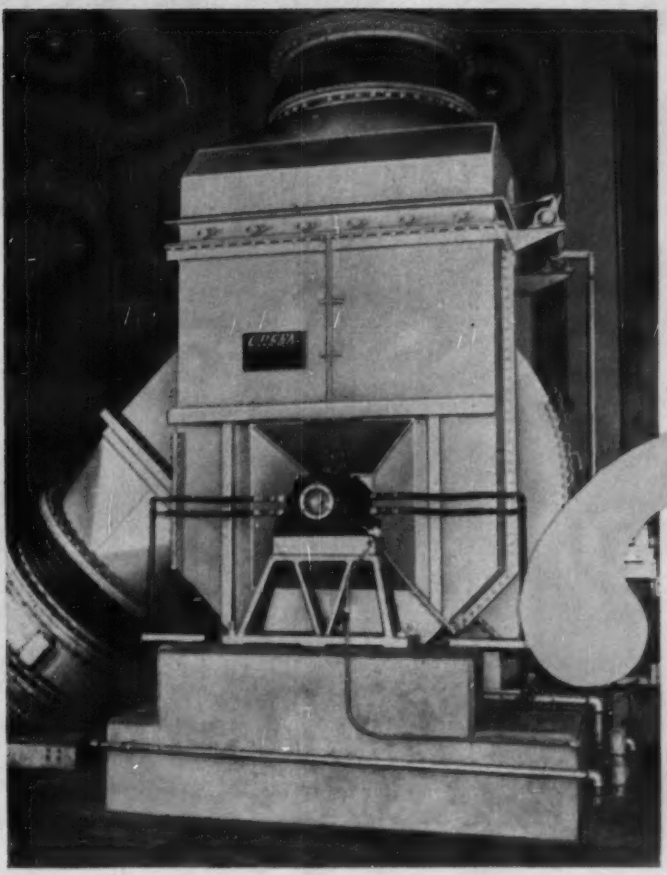
R-P&C VALVES

ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

For more facts circle 805 on Reader Service card, p 207



One of Brookhaven's three Green induced draft fans. Each exhausts 109,000 CFM at 56" S.P. and 140° F., operating at 1775 RPM. Each rotor was successfully subjected to spin tests producing 50% greater than normal operating stress.

WHY DID BROOKHAVEN SWITCH TO GREEN HIGH PRESSURE FANS FOR ATOMIC PILE COOLING?

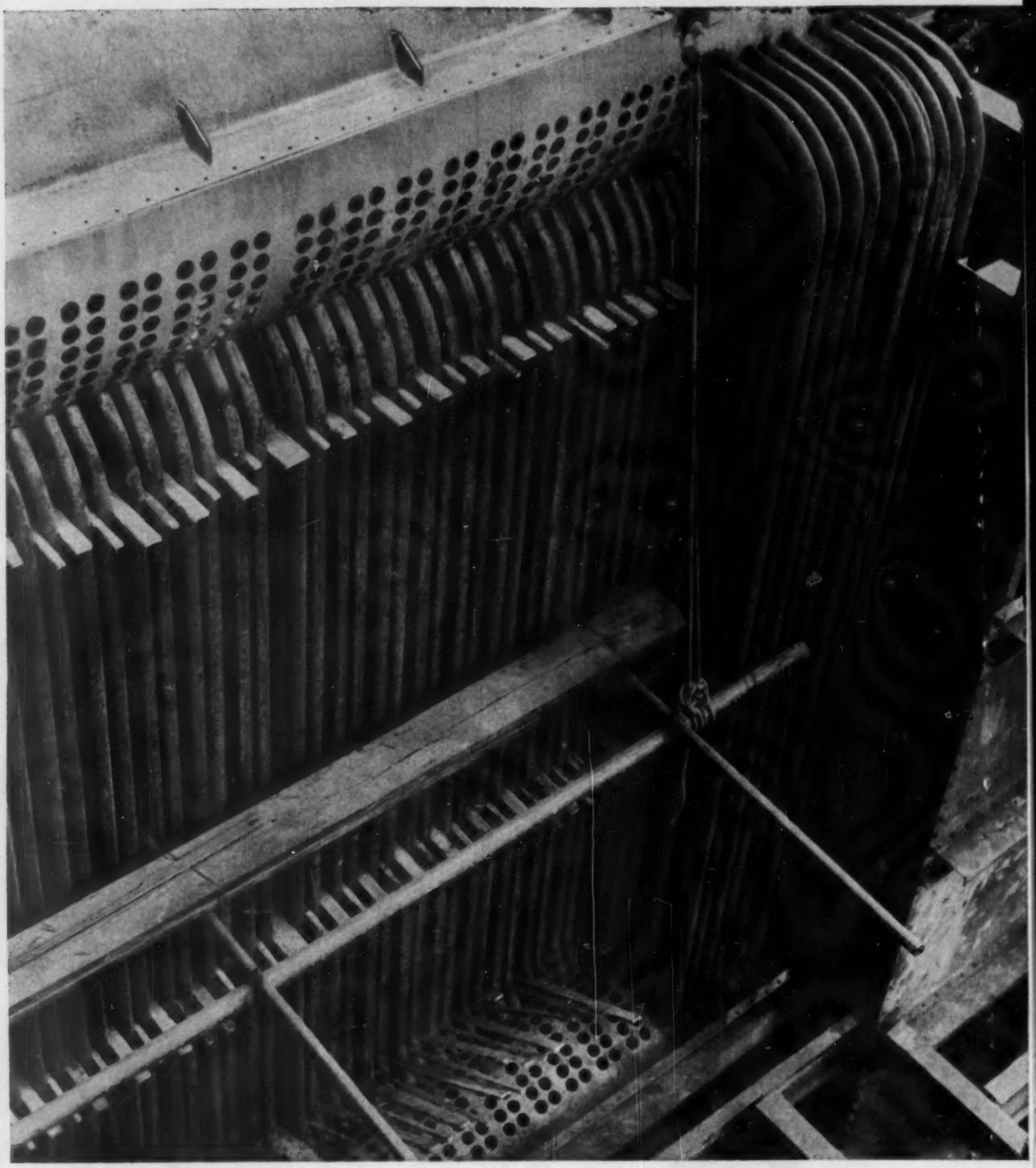
For 10 years, Brookhaven National Laboratory at Upton, N. Y. had used five fans of a leading make for exhausting the hot, slightly radioactive gases from its experimental atomic pile installation. These fans were still good, yet Brookhaven replaced them with three new Green units. Here's why:

Due to design changes in the atomic fuel, the air flow requirements changed considerably thereby making it economical to purchase new fans. This change in air flow requirements plus the new Green fans with their forged and machined rotors and efficient airfoil design (smoother air flow, less turbulence, less shock or eddy loss) save a total of $15/hour in power consumption. Not only does the replacement installation pay for itself, it gives Brookhaven brand new equipment, the most modern of its kind, built to provide the reliability their atomic application absolutely demands.

It will pay you—as it did Brookhaven—to investigate the replacement of your present fan equipment with new high efficiency Green airfoil fans.

Green

THE GREEN FUEL ECONOMIZER CO., INC. BEACON 3, NEW YORK



REPUBLIC ELECTRUNITE BOILER TUBES are produced from highest quality flat rolled open-hearth steel and manufactured by Republic's exclusive process that ELECTRically-UNITEs the tube under pressure without additional foreign or extra metal. Each length of ELECTRUNITE is hydrostatically or electronically tested to conform with applicable ASTM specifications, and the ASME Boiler and Pressure Code. ELECTRUNITE is specified for the big jobs because dependability is built-in. The ELECTRUNITE process assures uniform wall thickness, uniform ductility, uniform diameter, and true concentricity. Bends are smooth and uniform. Rolling-in operations are easier.

For more facts circle 807 on Reader Service card, p 207

POWER FOR PAPER MAKING...

with REPUBLIC ELECTRUNITE BOILER TUBES

Continuous, dependable power is one of the first requirements in paper making. That is why Republic ELECTRUNITE Boiler Tubes are on the job in the new boiler plant of the West Virginia Pulp and Paper Company, Covington, Virginia.

Erie City Iron Works, Erie, Pennsylvania, were designers, engineers, and erectors of the unit, producing 77,900 pounds per hour at a normal operating pressure of 170 pounds. Waste black liquor from digestion of pulpwood is burned in a rotary incinerator and the hot gases are fed into the boiler, producing steam, the power for paper making.

ELECTRUNITE is produced by an exclusive process universally accepted by leading technical authorities, code societies, boiler and heat exchanger manufacturers, Federal and State committees, and boiler insurance requirements.

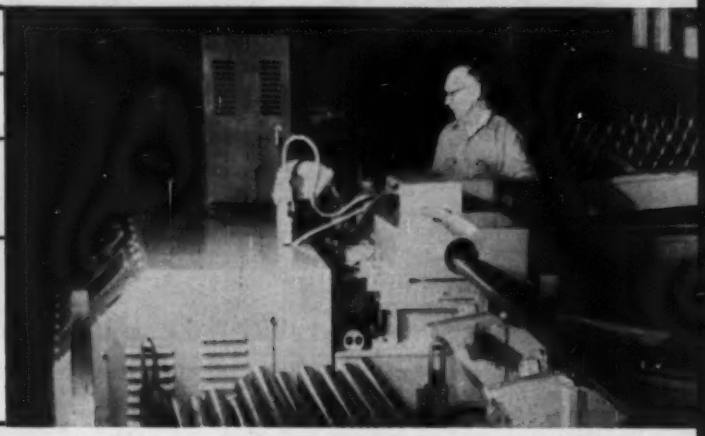
Full normalizing, uniform wall thickness, diameter, true concentricity, assure easy workability and inservice dependability. Bends are smooth, uniform. Rolling-in operations are easier.

To learn how ELECTRUNITE can offer you greater savings in installation time and operating costs, call your Republic Representative. Or write.

FARROWTEST REJECT TABLE

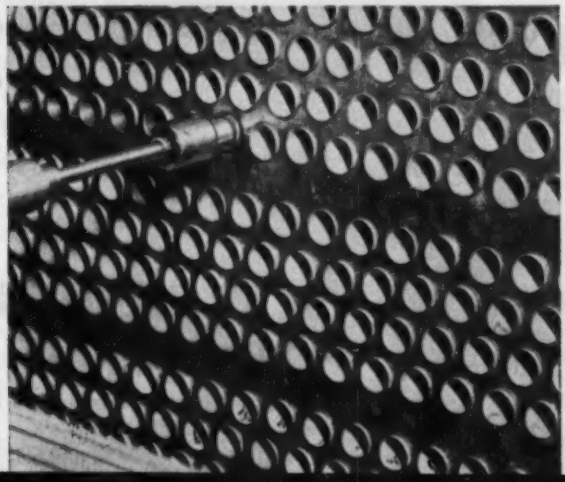
Wall Thickness (B.W. Gage)	Minor Dimension of Defect (Length or Depth)	Defective Area (Length, Depth Plane)
20	0.006 IN.	0.0025 Square Inches
18	0.006 IN.	0.003 Square Inches
16	12.5% of Wall	0.003 Square Inches
14 and 13	12.5% of Wall	0.004 Square Inches
12 and Heavier	12.5% of Wall	0.005 Square Inches

FARROWTEST detects and rejects not only tubing containing defects which completely penetrate the wall; but also tubing with defects equal to, or greater than, those shown in this table. For irregular defect shapes, a tube with defect area equal to or greater than shown above is rejectable. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.



FARROWTEST—QUALITY YOU CAN MEASURE. Not a laboratory theory, not a mere inspection tool, but an exclusive production test that detects and rejects tubing containing defects of critical size. FARROWTEST is offered as an alternative to other less positive tests in accordance with the table above, at no extra cost.

REPUBLIC ELECTRUNITE STAINLESS STEEL TUBING resists corrosion and provides long trouble-free service in heat exchanger, condenser, evaporator operations. When water is a problem, call your Republic representative, or send coupon for additional information.



REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
DEPT. PO-9757
1441 REPUBLIC BUILDING · CLEVELAND 1, OHIO

Please send more information on the following products:

☐ Republic ELECTRUNITE® Boiler Tubes ☐ FARROWTEST®
☐ Republic ELECTRUNITE Stainless Steel Tubing

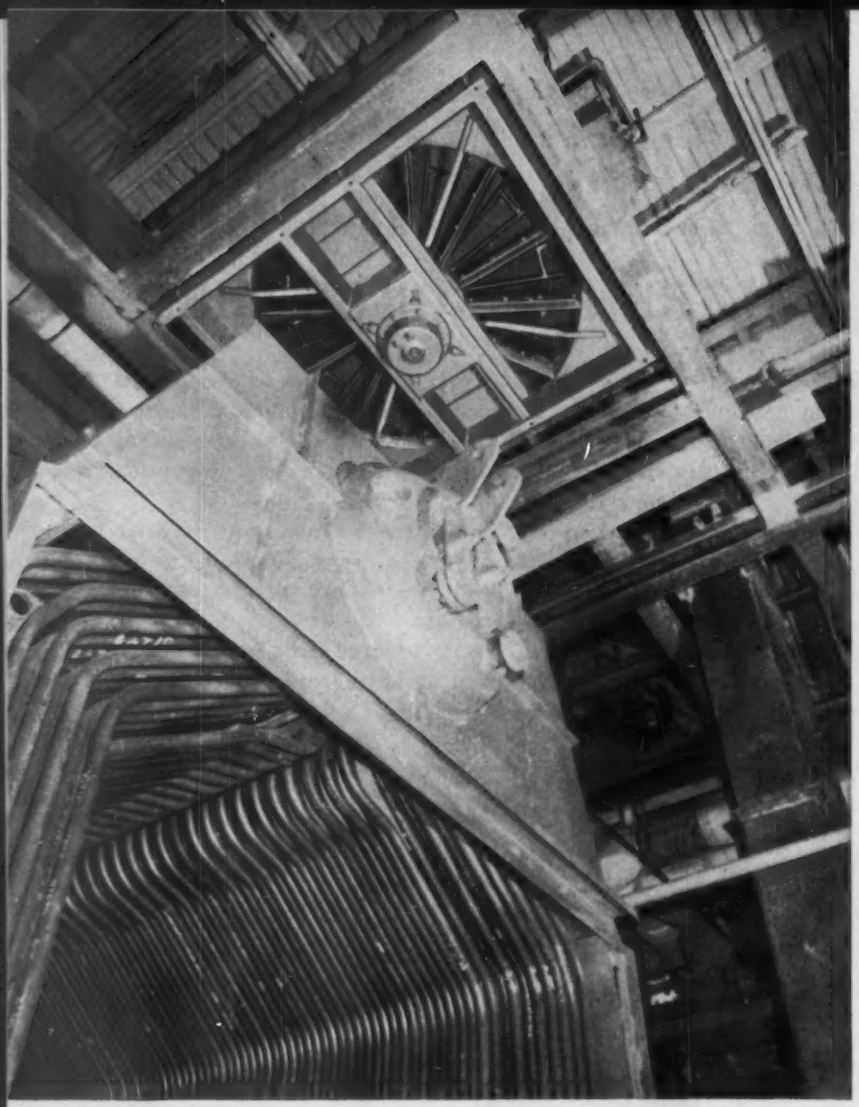
Name_____ Title_____

Firm_____

Address_____

City_____ Zone____ State_____

(Advertisement)



The Ljungstrom Air Preheater at the B. F. Goodrich Company Shelton Plant is installed directly over the 65,000 lb/hr Wickes boiler. Flue gas leaving the boiler at 615°F passes through the circular rotor, which absorbs the heat and releases it into the incoming air. Preheated combustion air improves combustion, makes fuel burn cleanly. This Package Air Preheater was factory-assembled, and requird only 100 manhours to install.

At B. F. Goodrich Co.'s Shelton Plant

Air Preheater boosts combustion air temperature 345°F... gives 6% more thermal efficiency

"Only a Ljungstrom® Air Preheater, with its continuous regenerative principle, could meet our requirements", says A. G. Sandomirsky, Manager of Engineering at the B. F. Goodrich Company, Shelton, Conn., plant. "We produce foam rubber 24 hours a day, five and six days a week. With an Air Preheater we can meet process steam requirements more economically, and an Air Preheater helped us to justify the installation of high efficiency, high pressure equipment for by-product power generation."

For more facts circle 808 on Reader Service card, p 207

Here's why the Shelton plant meets its requirements best with a Ljungstrom Air Preheater:

1. Ljungstrom is the most efficient heat exchanger you can buy. The Ljungstrom rotor revolves continuously through the flue gas and incoming air, thus absorbing heat and releasing it *from the same surface*. Since the heat doesn't have to pass through anything, each inch of rotor surface is as efficient as one foot of a tubular recuperator.

2. Ljungstrom is the most reliable heat exchanger you can buy. All heat exchange elements pass through the entire air and gas streams. The temperature of the elements in the coolest region – where fresh air enters – is actually an average of the gas and air temperatures, so it's consistently higher than the coolest point in a recuperative heat exchanger. Result: no cold spots, less chance of moisture formation.

3. Ljungstrom is easiest to maintain. You can inspect it – and clean it–while it's running. Heat exchange elements are divided into modular baskets that can be replaced individually without disturbing the other elements. You can even reverse the elements if the surface has thinned on one edge, effectively doubling the life of the heat exchange surface.

For more information on the Ljungstrom continuous regenerative principle, or on the Air Preheater that meets your requirements, phone MUrray Hill 2-8250 or write to The Air Preheater Corporation.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

NALCO'S OWN POPULATION BOOM...

(in Water Treatment Skills and Experience)

These are the Nalco people in the background* when a Nalco Representative tackles your water treatment problem. He can call on any or all of them when necessary . . . and the specialized skills and experience they have are strong support for his own expert knowledge of water treatment chemicals—and how plants should use them.

Nalco's population boom in water treatment skills and experience is simply further assurance that when you want water treatment *results* your Nalco Representative is the man to call.

**The technically trained headquarters people who conduct research and customer service work on every kind of water treatment problem.*

Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
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NALCO CHEMICAL COMPANY

6222 West 66th Place • Chicago 38, Illinois

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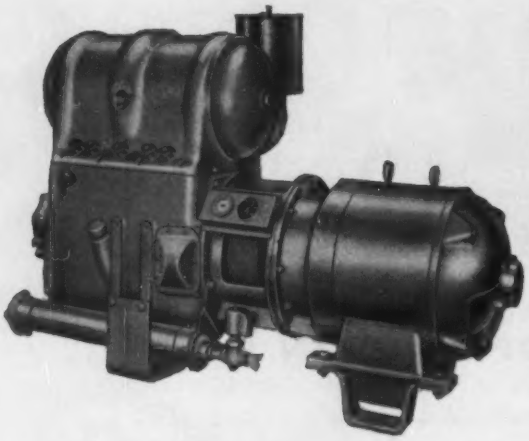
Nalco® . . . Serving Industry through Practical Applied Science

For more facts circle 809 on Reader Service card, p 207

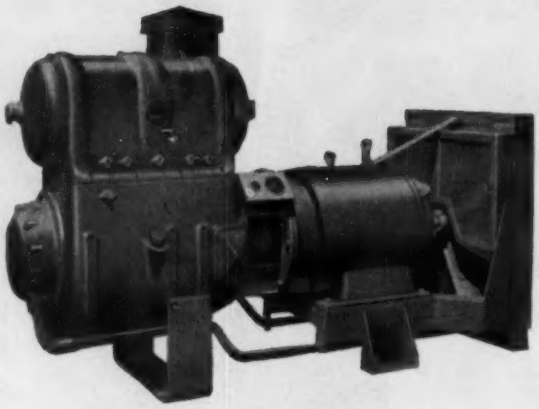
Only DAVEY offers both water-cooled and air-cooled rotary compressors of equal efficiency and long service life

HYDROVANE DAVEY

water-cooled



air-cooled



Davey stationary compressors are available in 2 to 125 h. p. @ 100 p.s.i. sizes

With Davey you can meet every compressor need—perfectly! For Davey gives you your choice of a complete line of both water-cooled and *air-cooled* Hydrovane Rotary units. These are equally efficient, economical to operate . . . built for long, trouble-free service.

This means you can now use air-cooled compressors in locations where water is not available or water cost savings are highly essential.

IMPORTANT: Oil consumption of Davey Hydrovanes is only a fraction (often less than 10%) of that of other rotary compressors. In fact, Davey Hydrovanes use no more oil than ordinary reciprocating units. *Also, only Davey offers long-life Perma-Vane* blades.* These eliminate blade deterioration and breakage—biggest source of rotary compressor trouble.

See your local Davey distributor today! Or, write for Bulletin E. A-5699A

*U.S. Patent No. 2,905,376

DAVEY pioneers of air-cooled air

Industrial Division

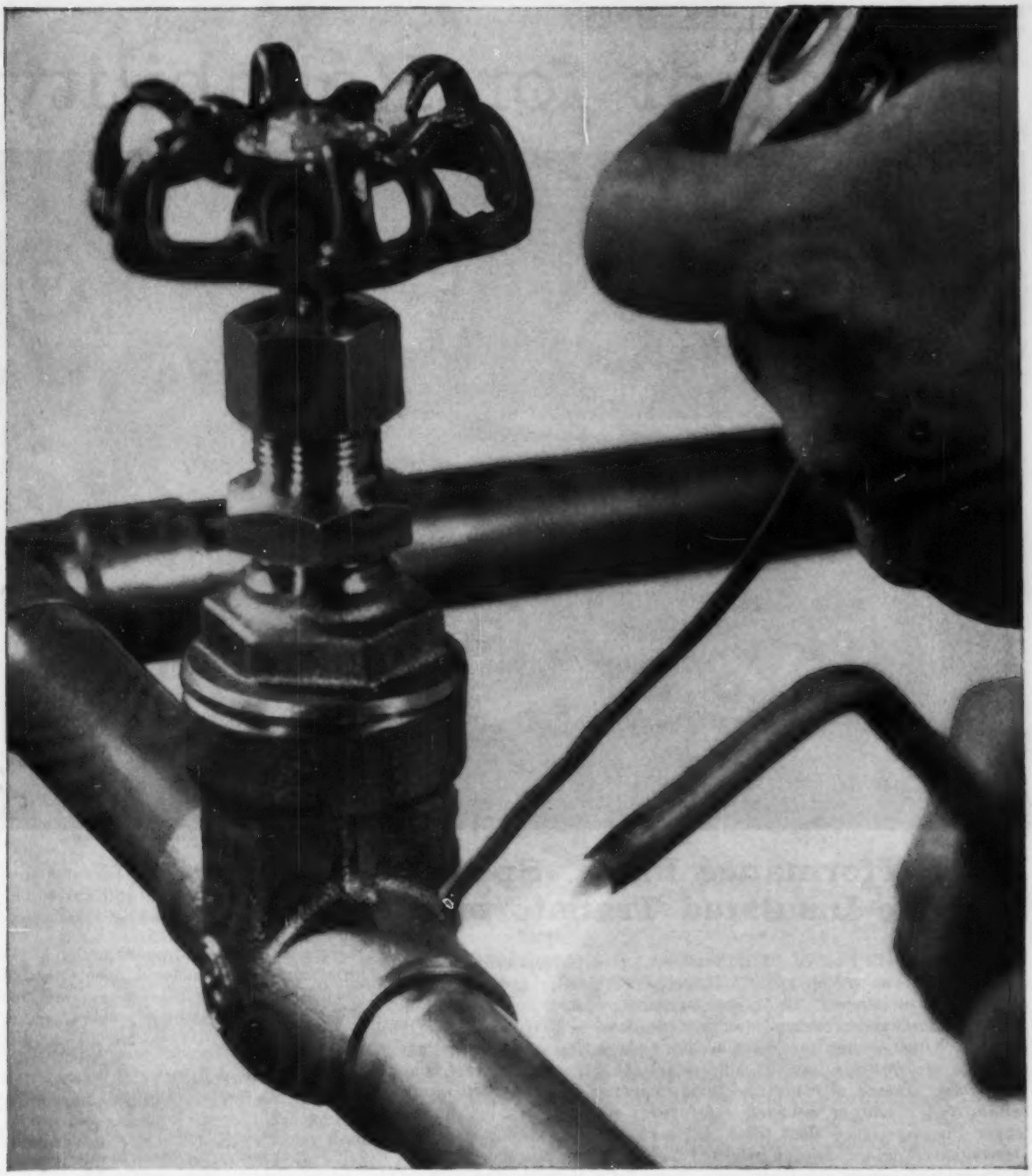
DAVEY COMPRESSOR CO.

Kent, Ohio

Distributors in All Principal Cities

See us at the Power Show, Booth No. 622

For more facts circle 810 on Reader Service card, p 207



MEN WHO INSTALL O-B solder end valves know the O-B design lets tube ends reach heat uniformly with minimum torch time. Solder flow is smooth. Maintenance is minimized. Continuous service is assured by a safe, leak-tight joint. Ask your distributor for the valve in the orange-and-black box.

OHIO BRASS COMPANY • Mansfield, Ohio

O-B VALVES

10074-V

For more facts circle 811 on Reader Service card, p 207

SILICONE NEWS from Dow Corning

Blueprint for Reliability

For Performance Plus...Specify Silicone Insulated Transformers

Here's Why—(1) *Low cost installation* . . . transformers using silicone insulation systems are up to 50% lighter, 50% smaller and require no costly vaults or barriers. (2) *Lower operating costs* . . . silicone insulated transformers are virtually maintenance-free — have no liquids to filter or change — need no space heaters to keep de-energized windings dry. (3) *Maximum safety* . . . silicone insulated transformers are completely dry. There's no danger of toxic fumes, or fire. (4) *Maximum reliability* . . . silicone insulated transformers operating at 200 C have a longer life expectancy than Class A transformers operating at 100 C. Depending on design, silicone insulated transformers withstand overloads of 25 to 50% above rated capacity. Units have been flooded without damage to windings.

Here's How — Dow Corning silicone insulation has excellent electric strength and is unaffected by thermal cycling and high temperature . . . enables transformer manufacturers to (1) produce lighter, more compact units — units that double capacity without increasing space or weight requirements; or (2) build units that withstand substantial overloads.

Here's What — Silicone insulated dry-type transformers in three enclosures: (1) open, (2) enclosed and (3) gas-filled sealed.

Here's Where — For power station auxiliaries, a choice of enclosed, open or sealed gas-filled dry-type transformers — and, for underground distribution systems, sealed gas-filled dry-type transformers.

Here's When — Right now! Whether you are planning for future growth, expanding present facilities or replacing old equipment, consider the possibility of using silicone insulated transformers. Initial price is competitive, and, when you consider their lasting values, silicone insulated transformers give you more for your money . . . a whole lot more!

Write today for 8 page brochure entitled "Specify Silicone Insulated Motors and Transformers and Save!"

You Save by Specifying Silicone Insulated Transformers. Write Dept. 7010.

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

For more facts circle 812 on Reader Service card, p 207

LOUIS N ROWLEY, EDITOR • OCTOBER 1960 • ESTABLISHED 1882 **Power**

Are we starving progress?

At first blush, the question above doesn't seem to have much to do with the subject of equipment purchasing we started to talk about in last month's editorial—and perhaps even less to do with *plant design*, the theme of this annual issue. Yet, it isn't a mere "teaser". By the time we reach the bottom of this page I hope to convince you that purchasing plant equipment on a "price" basis can have even more serious consequences than the "high cost of buying cheap" stressed in POWER's September editorial.

Even the quickest of looks around the energy-systems field reveals the enormous strides that have been made over the years. Generating stations continue to extract more kwhr from a pound of fuel. Electrical distribution systems handle with ease the ever-increasing demands of industry. Air-conditioning and refrigeration systems control plant climate more precisely. Everywhere you look you see higher efficiency, greater capacity and more automatic control—all the elements of improved performance.

These advances didn't just happen. They result from increasingly sophisticated plant design, embodying improved equipment of all types. The improved equipment comes from progressive manufacturers who invest in research and engineering, confident that discerning plant designers will recognize the extra values built into their products. This is the essence of free enterprise—the idea that an improved product will find larger markets and command a price in line with its value.

When we buy equipment primarily on the basis of *price* we literally strike a blow against this basic concept. We say, in effect, that all equipment is the same and that the only difference is the price asked for it. And in an economy where this attitude prevails, where there is no reward for leadership and innovation, technical advance is bound to grind to a halt. Progress *can* be starved and every time we let an equipment purchase be decided on price alone, we contribute in a small way to this starvation process.

As engineers, we know that equipment is not all the same. We know that in any given category there will be a host of differences in performance, in quality of construction, in ease of maintenance, to name but a few. We know these technical differences represent differences in *value* and we are trained to discern and evaluate these value differences in relation to the price asked. But this is not the end of the matter. Because of our special knowledge in this area we have a responsibility to top management, particularly financial management, to make these differences clear, to show their dollars and cents significance, to fight unremittingly for the *best value* as distinguished from the best price.

We cannot abdicate this responsibility, to do so is alien to all our training and beliefs as engineers. And by discharging this responsibility fully, we not only secure the best long-run bargains for our companies—we also help insure a climate in which leadership and innovation are properly rewarded and in which technical progress can flourish.

For fuses with 200,000 ampere interrupting capacity...

***plus,* extreme current-limitation**

plus,* time-lag to prevent needless blows–*you need . . .

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Buss LOW-PEAK Fuses are designed to meet modern demands for electrical protection.

They safely interrupt fault currents up to 200,000 amperes . . . limit let-thru current to exceptionally low values . . . and hold 500% load for minimum of ten seconds.

Protect Mains, Feeders, Branch Circuits, Motors, Controllers, Switches—no matter whether the fault current is 1,000 amperes, 25,000, 100,000—or as high as 200,000 amperes.

Reduce stresses and prevent damage to Panelboards, Switches, Motor Controllers—other circuit components—because let-thru fault currents are limited to exceptionally low values.

Can be easily co-ordinated into a selective system—to limit fault outages to circuit of origin.

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Provide thermal protection for equipment against damage due to poor contact.

Protect against waste of space and money by permitting the use of proper size switches and panels.

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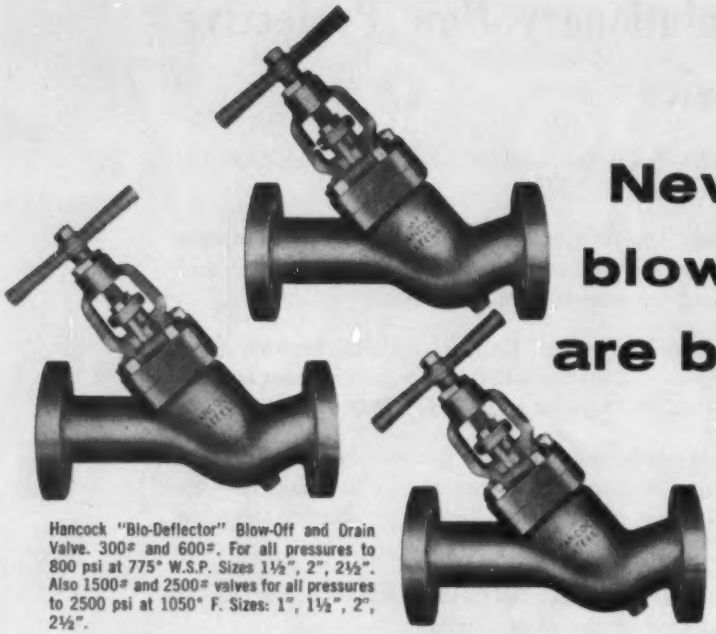


Hancock "Blo-Deflector" Blow-Off and Drain Valve. 300# and 600#. For all pressures to 800 psi at 775° W.S.P. Sizes 1½", 2", 2½". Also 1500# and 2500# valves for all pressures to 2500 psi at 1050° F. Sizes: 1", 1½", 2", 2½".

New Hancock blow-off valves are boiler tough

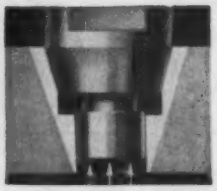
Forget about plungers, springs, lubricating fittings and special packing, or seat threads. These new Hancock 300# and 600# Blow-Off and Drain Valves are simply designed and constructed. But that only partly explains why they rarely need attention and last for the life of your boiler.

The unique "Blo-Deflector" seat and disc makes it impossible for fast-moving water to cut the disc's seating surface.

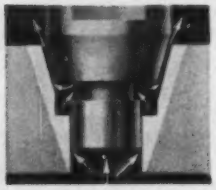
There is no wire drawing or erosion because both integral seat and the disc are Stellite faced. Shut-off is tight and dependable; no costly losses of heated boiler water.

No bonnet joint leaks, either! Properly compressed between the thick body and bonnet flanges is a recessed Flexitallic sealing gasket that cannot blow out.

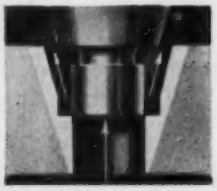
Hancock Blow-Off and Drain Valves always operate easily; no stem binding. They can be repacked under pressure, and surpass all stationary and marine codes, and insurance requirements. Your industrial supply distributor will gladly give you more details. Write for Bulletin 235.



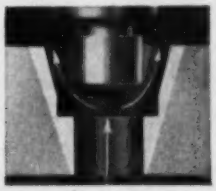
The Hancock "Blo-Deflector" valve seat and disc in the closed position. Pressure from the boiler is indicated pushing upwards under the valve disc.



As the valve starts to open, a small amount of water shoots upward . . . loses its fight as it hits the protecting lip and washes harmlessly across the seat as the valve is opened further.



When the piston leaves its guide, the seating surface of the disc is completely out of the line of flow. This makes it impossible for the velocity of the water to cut the seating surface of the disc.



Above picture shows valve in open position. Observe that neither shut-off surface is affected by the flow. Resulting in long, repair-free life of these "Blo-Deflector" Hancocks.

HANCOCK BLOW-OFF VALVES

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MANNING, MAXWELL & MOORE, INC.

Valve Division • Watertown, Massachusetts

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1

Power **reports on . . .**

Industrial-Plant Design

A changing picture of production demands, plus the ever-present challenge of growth, sets the stage for many design advances within the broad field of energy-systems engineering. Here are some highlights:

Total planning with an eye toward holding future maintenance costs in line is getting more attention. There is growing emphasis on noise control and development of super-clean production areas. **P 68**

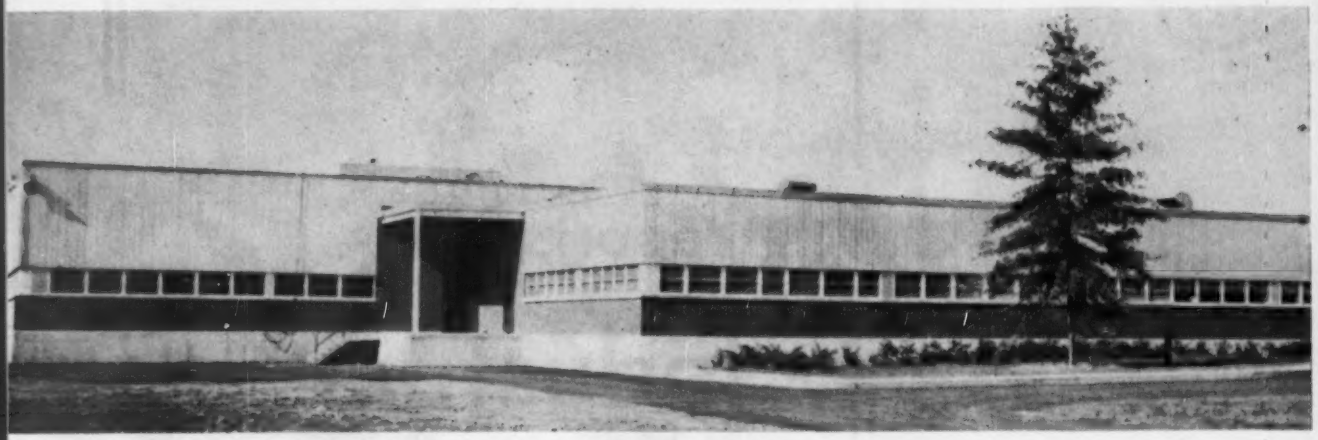
Materials, both new and improved, are coming to the front to meet tougher demands in energy systems. Typical challenge: developing materials for sustained operation at very high temperatures. **P 71**

Cryogenics—the science of producing very low temperatures—has grown from lab toy to industrial process. Among many applications being studied is the storing and transporting of natural gas. **P 75**

Busways are taking over bigger share of electrical distribution with continuing growth of load concentration and need for greater flexibility. Applications are still within the 600-v class. **P 80**

Lubrication continues to get attention as equipment life stretcher. New twists: applying an oil mist from a 10,000- to 25,000-ssu source, timed injection of oil into bearings to offset cavitation. **P 85**

Steam-turbine control using electric-hydraulic governing meets demand for better wide-range speed control. Solid-state computer and electric-hydraulic transducer are the operating core. **P 88**



YOUR NEW PLANT ...must be designed for tomorrow, with PM as the key

"Now here, you see, it takes all the running you can do to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that." So said the Red Queen to Alice, in Lewis Carroll's famous childhood fantasy, *Through the Looking-Glass.*

Every wide-awake and well-informed plant engineer knows only too well how right the queen was, especially when it comes to planning a new plant or expanding an old one. New materials, new machinery and new techniques are developing so quickly that unless we look way ahead, we're liable to be left far behind just a few short years after the new plant is completed.

"What planning should go into our modern industrial and utility plants—both in buildings and machinery—to reduce or hold in check the ever-expanding maintenance costs and to make it a more enjoyable place to work?" We asked this question to some of the country's top industrial architects and engineers. Here are the highlights of these informative and thought provoking discussions.

Everybody's party

"Unless you bring key operating and maintenance personnel into the picture right from the first step, the design stage, you can expect trouble." Everyone we talked with is unanimous in this view. Once the plant is complete, it's the operating men who must live with it and are married to it for life —so cash in on their experience.

Many plant engineers have their maintenance department check out final drawings before equipment is installed. These men have the practical knowhow to check out many things learned from costly experience. Example is making sure there is enough space around a heat exchanger to replace or clean a tube bundle.

Maintenance and repair costs of our leading industrial plants in 1959 were over 67 percent of the amount retained as net profit. This means that for every dollar of net profit, more than two thirds was paid out for maintenance and repairs.

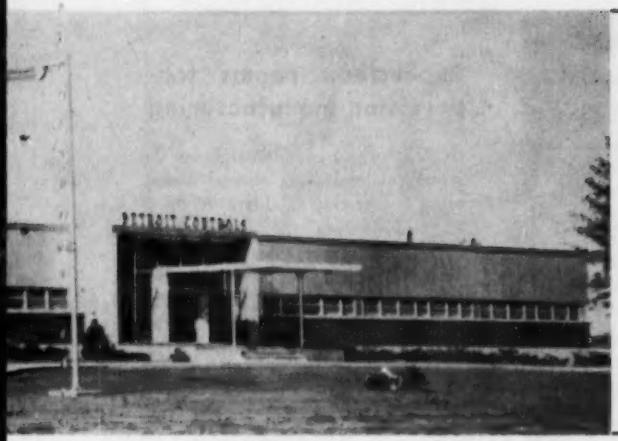
Because PM is a major item—let the boys who will be responsible for it have their say now. One criticism they'll have is inadequate space: not enough space around machinery to allow proper maintenance; not enough overhead room to swing components clear—thus making extra work, taking more time to do the job, running up cost.

Did you pick the right site?

Study the plant site for present air-pollution conditions. Know what pollutants, if any, your plant will discharge into the atmosphere. Remember that the most economical way to control air pollution is not to let it start. After checking the local ordinances you will know just how efficient your control must be over air pollution. This indicates stack height, types of dust collectors and discharge fume scrubbers to install. Today, your neighbors are air pollution conscious and will let you know it.

Study waste disposal problems—also supply and cost of water for cooling and for other uses. Depending on your needs, these items can be the tail that wags the dog when selecting a site.

Noise is another nuisance that many neighborhoods are conscious of. Check the new site for



A standout modern industrial plant . . .

is this Stratford, Conn. office, foundry and manufacturing building for Detroit Controls Div of American Radiator & Standard Sanitary Corp. It was designed by Fletcher-Thompson, Inc of Bridgeport, Conn. Layout of site and building provides maximum usable space with inevitable expansion in mind. Materials and methods of construction were studied to insure minimum initial investment. Heating, piping and electrical systems were selected for economical installation, efficient operation, low maintenance costs. Then a team of highly skilled architects and engineers welded all these factors into a satisfying design.

noise from railroads and industrial plants feeding back through the soil. Also your own noise from annoying your neighbors. This may save you costly litigation later on. But more important, it will dictate the proper approach for an efficient noise-isolation program. Once the site is approved, you can start thinking about the new building.

Building can be streamlined

Economical cost and flexibility comes first when looking ahead. Think of expansion in five- and ten-year periods. Buildings today are usually large one-story constructions on sizable grounds.

Use curtain expansion walls on sides where building may have to push out later on to accommodate growth; isolate to prevent vibration transmission through the building columns. One way to do this is by putting lead-asbestos pads under the columns. Where delicate electronic data-processing or lab equipment is used in special rooms, consider a floating floor above plant floor proper, isolate underneath. And look into viscoelastic-damped building structures for this purpose. (See *Vibration Isolation*, a POWER special report, August 1960). Also use dustproof floors or floor coatings where possible to avoid raising dust that settles on delicate equipment and process.

Install sprinkler system in all critical areas. Work out economics of fireproofing underside of asphalt-covered metal roofing by spraying with asbestos composition (don't forget the $35-million fire at General Motors' Livonia, Mich. plant).

Take a hard look at floor drainage—don't run the risk of flooding electrical equipment. Where floors may get wet, raise and slope them away from stairways, doors, elevators and other openings.

Equipment specifications

Here's a subject of vital importance. One miscue and you can pay dearly in maintenance costs for years to come. A leading firm of architects and engineers told us that they never use an "or equal" type of bid in their specifications. It's always the "modified-base" bid, meaning they specify by brand name every piece of equipment that goes into the new or remodeled plant.

First they make a complete study of equipment and materials with which they are not too familiar. Usually they will not specify any item that has not had at least two years of field testing. Then they insist on naming the manufacturer of electric cables, wiring, piping, valves, etc. Their contention is that this is where preventive maintenance begins, and they have saved clients many dollars through the years by insisting that specs be followed to the letter.

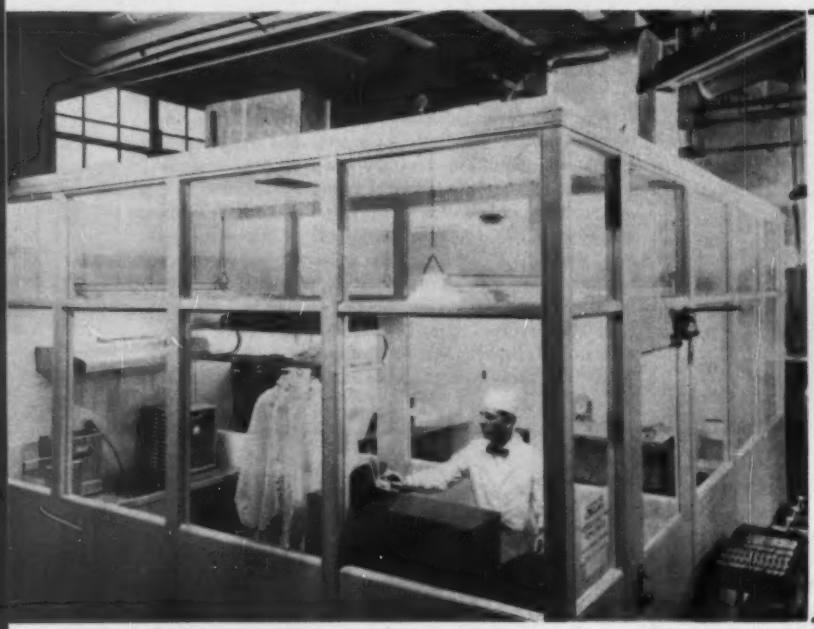
And select the right equipment

The equipment you select will have a lot to do with how difficult and expensive your maintenance program proves to be. Problem is to balance necessarily higher first cost of such low-maintenance equipment against year-in and year-out savings it will produce. And, when the payout is there, to put the idea across to top management.

To a growing extent, the solution to rising maintenance costs is going to lie in eliminating the need for maintenance and, where maintenance is inevitable, making it easy.

Equipment designers are already working on these lines. More and more alloys and special materials are used to lengthen life of parts subject to corrosion and abrasion. Unit sub-assemblies are designed for quick replacement. And we already have equipment built to require no attention during a normal lifetime. Typical: the sealed-for-life electric motor in wide use today.

For some time, equipment designed along these maintenance-reducing lines will run higher in first cost. But as maintenance costs rise, more and more plant managers will become convinced that the extra investment will pay long-term dividends. In the long run, the best will prove the cheapest.



Superclean rooms for precision manufacturing

Getting to be a common sight on the industrial landscape: special assembling and testing facilities set up in a "white room" for microscopic cleanliness. Atmosphere stays virtually dustfree here, with electrostatic precipitation filtering dust particles down to 1/150th of a micron. Operators wear rubber overshoes, lintfree outer clothing and head covering, rubber gloves. To be sure of constant and reproducible test conditions, temperature is kept at just 69 F, relative humidity at precisely 50%. In photo, valves for missiles are made under these microscopically clean conditions, assembled and hermetically packed.

Keep it clean and very quiet

A generation ago, no one worried much about plant cleanliness or noise control. Today, industry is giving these factors some serious thinking. Cleanliness and quiet, built right into the plant, pay off in health, efficiency, increased production quality.

Simplest way to keep some industrial plants clean: divide them into two zones. The immaculately clean zone is completely isolated from the unavoidably dirty area. Of course, although the "dirty" operations are separate, it's still to your advantage to have them as clean as possible.

In the clean area, air scrubbers, electrostatic precipitators and filters work over the air and eradicate dirt, both for the health of employees and to turn out a more efficient and salable product. Some of these clean areas resemble a hospital ward, with workers dressed in white like nurses and interns. For ultracleanliness, a "white room," above, can be installed inside the clean area. This room is used for cleaning and assembling delicate instruments, rolling-contact bearings and other components of critical equipment. Manufacturers of electronic and electrical assemblies, plastic-and-metal components, optical glass, jewelry and surgical instruments are just a few using white rooms.

Unless the tiniest particles of foreign matter floating in the air are kept out of newly assembled precision parts, eventual failure is a big risk. Rolling-contact-bearing makers tell us that 90% of bearing failures come from tiny particles that find their way into bearings during assembly, maintenance or relubrication. So standards of cleanliness are set up, components tested after assembly and cleaning. One instrument measures smut residue. Soil is removed from the surface with a pressure-sensitive tape fixed to a miscroscope slide. Then instrument measures optical density of the composite—tape, soil and slide.

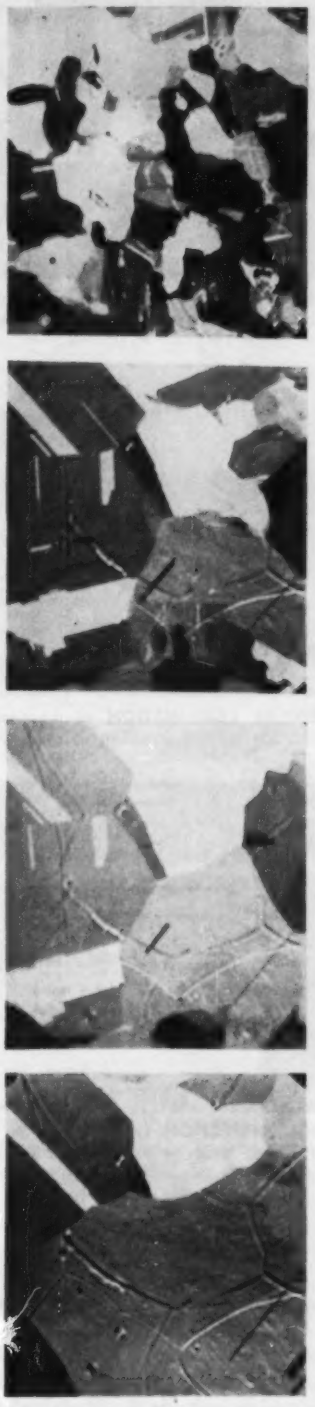
In many plants, a new or repaired machine is cleaned ultrasonically before assembly—ultrasonics here supplements the conventional methods. Maintenance shops, too, find ultrasonic cleaning quick and efficient today.

Eliminating noise is one of the first things an alert manufacturer has in mind when designing his new plant. Today we know that excess noise results in loss of efficiency and even impairment of hearing. With modern methods buildings *can* be quiet, despite production machines, the whir of air conditioning, the noise-carrying characteristics of air ducts and lightweight partitions.

First of all, sound-absorbing ceilings and walls are placed in many areas. New acoustical materials are coming into use almost daily: one firm has an integrated ceiling system incorporating heating, cooling and noise control. It includes perforated metal tiles, heating and cooling coils installed above the tiles and insulation blankets to cover the coils.

Vibration and its concurrent noise are eliminated in rotating equipment by dynamic balancing. For further improvement, vibration isolators go in. Internal-combustion engines exhaust into silencers. Production machines are designed with fiber gears driving metallic gears.

As a last resort, if machinery cannot be quieted down sufficiently, try installing it in a special "noisy-machine enclosure." Here the machine rackets away to its heart's content, while the acoustically isolated enclosure confines the noise, keeps it safely away from employees and the plant in general.



THERMIONIC-EMISSION electron microscope observes behavior of metals at high temperatures. 'Scope shows how SAE-1080 steel, magnified up to 3000 times, changes at temperatures ranging from 1800 F, top, to 1950 F, bottom

MATERIALS

. . . to successfully meet desired service conditions are basic to systems design

Today's ceaseless research is improving existing materials, evolving new ones and ways to apply both with more efficiency. This increases ability of the equipment designer and the consulting engineer to provide peak performance at lowest overall cost to management.

This end result has always been the inherent desire of a competent designer-consulting-engineer team, but their efforts were hampered from the time of the industrial revolution until shortly after the turn of the 20th century. Boilers and unfired pressure vessels were subject to relatively low pressure-temperature conditions; piping, valve and fitting design was geared to these conditions; rotating- and reciprocating-machinery components dealt with low-speed operation and modest pressure. Materials were generally "good enough"; more strength usually meant added thickness.

Pressure-vessel, piping and machinery designers visualized and desired higher strength-to-weight ratios. But metallurgy, as such, was barely in swaddling clothes and the bulk of fabricating was done without benefit of machine tools, so material-selection freedom was limited.

Industrial expansion began to force development in metallurgy and fabrication methods. The steam boiler, prime factor in supplying heat energy for power generation and industrial process needs, had to move with the tide. Demand for higher-temperature steam meant increasingly higher operating pressures. There was a need not only to improve fabrication workmanship but also to standardize specifications covering the raw materials used. Inspection and testing standards were needed to guarantee quality of workmanship and materials.

Formation of the ASME Boiler Code committee in 1911 met this need, and the committee continues to set standards governing minimum requirements for boiler construction.

But along with steadily increasing pressure and temperature conditions came new problems caused by materials' behavior under these conditions, problems often compounded by the debilitating effect of various forms of corrosion and abrasion.

Research: vital factor

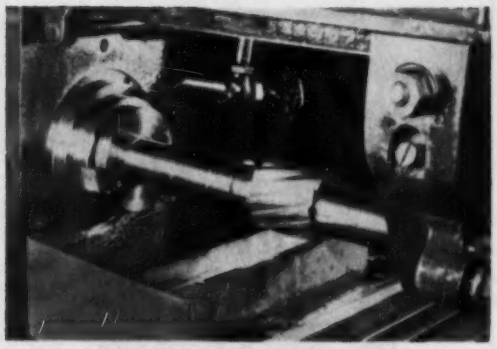
Design problems reared their heads principally in the vital power-generating industry and in larger industrial plants using comparable firing practices and steam conditions. To find the answers, some boiler and associated equipment manufacturers set up research and development laboratories—some of which have been greatly expanded in recent years. Both waterside and fireside difficulties beset boiler-drum and -tube materials, aside from stresses involved in high-pressure high-temperature operation.

These laboratories were and are determined to produce economical solutions. In overcoming water's "universal-solvent" characteristics and corrosive effect and at the same time providing high-purity steam at the nozzle, feedwater-treatment technology has reached a high degree of effectiveness with economic feasibility.

On the metal's fireside, the picture isn't quite as bright, particularly in the superheater area. As steam temperatures rose, it quickly became apparent that keeping tube material cool enough to remain stable was going to be a hard nut to crack. Continuous research with stainless steels—keeping a weather eye on cost—has produced reasonably successful operation at 1050 F. Some stainless materials have been used at higher superheat temperatures, but with less than complete success. As one prominent boiler manufacturer puts it:

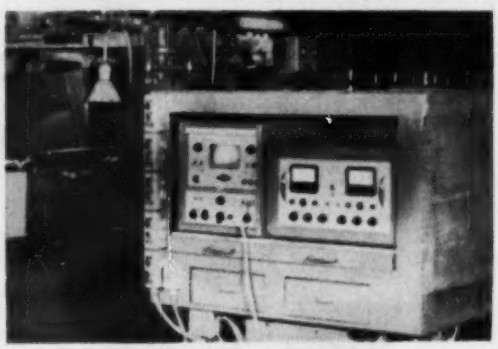
". . . Experience has re-emphasized the advantages and desirability of conservative design practices in superheaters and reheaters for 1050-F steam temperature and above. High steam temperature requires tube-metal temperature at close to the creep and corrosion limits of economically available materials. It is going to take a great deal of hard and expensive work before this problem is solved. Manufacturers are going to be very happy to develop an economical superheater and turbine alloy that can withstand commercial operating conditions with steam superheated to a range from 1300 to 1500 F. This would be a major achievement in itself."

Obviously, then, the greatest single roadblock is lack of materials suitable for sustained operation at very high temperatures over long periods of time. But confidence is placed in current research and development programs—so much that one boiler manufacturer is investigating a design to operate with gas temperatures in the range of 5000 F. An ambitious project, when one recalls that the best



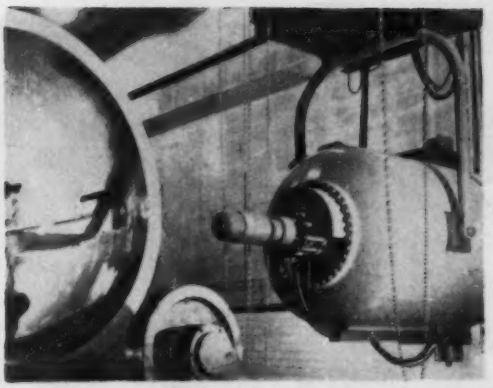
STRIP SAMPLE milled from full cross section of steel strip is chemically analyzed for product quality control

METALLURGICAL EXAMINATION of macroetched steel are examined for pattern structure of grain and defects



ULTRASONIC INSPECTION spots defects on continuous product. Faults in welds or material are located by area

MAGNETIC PARTICLES paint fluorescent picture of any defects originally located by ultrasonic inspection procedure



X-RAY INSPECTION by 2-million-volt machine will detect subsurface flaws in metal plate up to 10-in. thick

alloy steels in commercial use melt at about 2900 F.

Another side of the problem, and adding to it, is severe corrosion resulting at elevated temperatures when boiler metal is exposed to products of combustion of residual-oil fuel (see *Fuel ash corrosion: a continuing battle,* POWER, April 1960, pp 83-7). Fuel-oil ash has little respect for alloy steels used in high-temperature zones, ravages practically all. Research people spotted numerous material samples in boilers, checked countless data on time, temperature, corrosion rate. Current conclusions: for the time being, chemical additives used with residual-oil fuel are the best line of defense until a metallurgical breakthrough occurs.

In some alloys, corrosion was better inhibited by additive use than others, though results depended upon corrosive agent present in the fuel. MgO as an additive showed definite promise in deterring corrosive effect of a combination of sodium and vanadium. Limited data available shows a type 310 stainless steel suffers corrosion rate of 0.007 in. per year when MgO additive is used. Steel exposed to residual-oil fuel minus the additive has a corrosion rate of 0.167 in. per year. Also improved by the MgO additive to the point where their corrosion rates might be considered acceptable: types 406, 446, 302 and 302B. All showed corrosion rates of less than 0.05 in. per year. When residual-oil fuel was used without the additive, rates ranged from 0.108 to more than 2.0 in. per year.

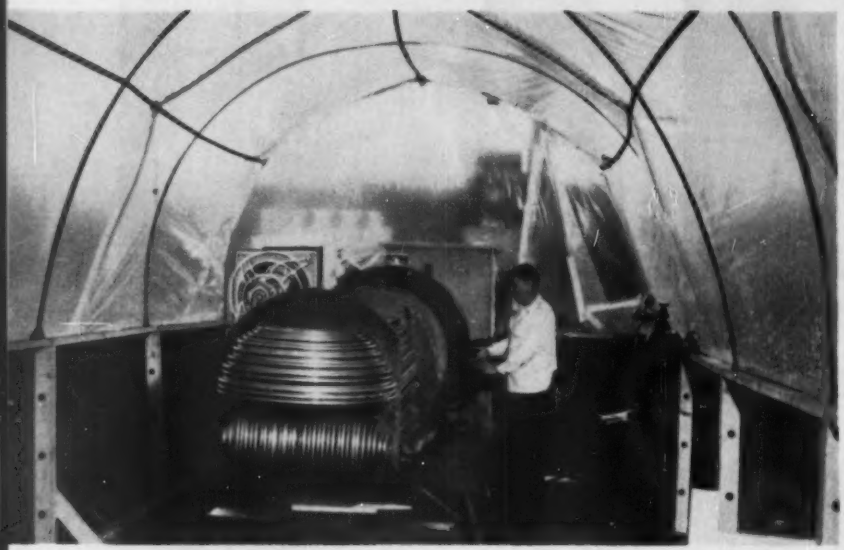
Steam and gas turbines, subject to stresses from their rotating parts in addition to those caused by temperature and pressure, have benefited by availability of new and improved alloy steels. Moving strongly into the steam- and gas-turbine fields, research has taken significant strides. Here, strength-to-weight ratios made possible by advances in metallurgy, design and fabrication have kept physical size of the units within limits that would have been thought impossible 30 years ago.

Components of other central-station and industrial energy systems show evidence of much successful research and development of materials. Metallic and nonmetallic parts, from large assemblies down to gaskets, nuts and bolts have proved performance characteristics possible only through costly and infinitely patient research. And "costly" is the right word—we're spending some $10-*billion* a year on research purely for civilian needs.

Materials inspection and testing techniques move apace with—and often are a vital part of—today's research and development efforts. Consider the equipment designer of yesteryear who could do little more than test a prototype to destruction to prove his product's ability to handle the desired job. Even then, results were often far from conclusive. Today, a host of *nondestructive* testing methods and tools provide bedrock proof of the pudding.

Gone are the days when raw-material production wavered up and down a considerable quality range. In steel making, for example, today's careful, scientific control measures produce heat after heat as alike as peas in a pod. Results are checked and proved by chemical analyses and metallurgical examination.

In chemical analysis of steel, samples from each heat—milled from a full cross section of a representative strip—are analyzed to insure that the steel complies with specification and end use. In the metallurgical examination, microscope development—itself a prime example of research—reveals a material's most intimate details. Note, for example, how the recently developed thermionic-emission electron microscope can magnify a metal sample up to 3000 times, show microstructural changes occurring at temperatures ranging from 1800 to 1950 F (top to bottom, p 71). This microscope and other tools and techniques typified by photos on these pages have developed along with materials through research efforts to eliminate



PORTABLE CLEAN ROOM erected on plant floor is example of research efforts to protect critical welding

guesswork from designed in-service performance.

Metallurgical examination, in addition to microscopy, involves macroetching and examination for pattern structure and defects such as segregation, voids or inclusions.

Ultrasonic inspection, another quality-control measure coming into more widespread use, can detect faults otherwise difficult to uncover without destructive deformation or rupture.

Magnetic particle examination backs up ultrasonic testing by exploring suspect areas. Used in conjunction with the manufacturing operation, this inspection tool helps determine causes of questionable quality.

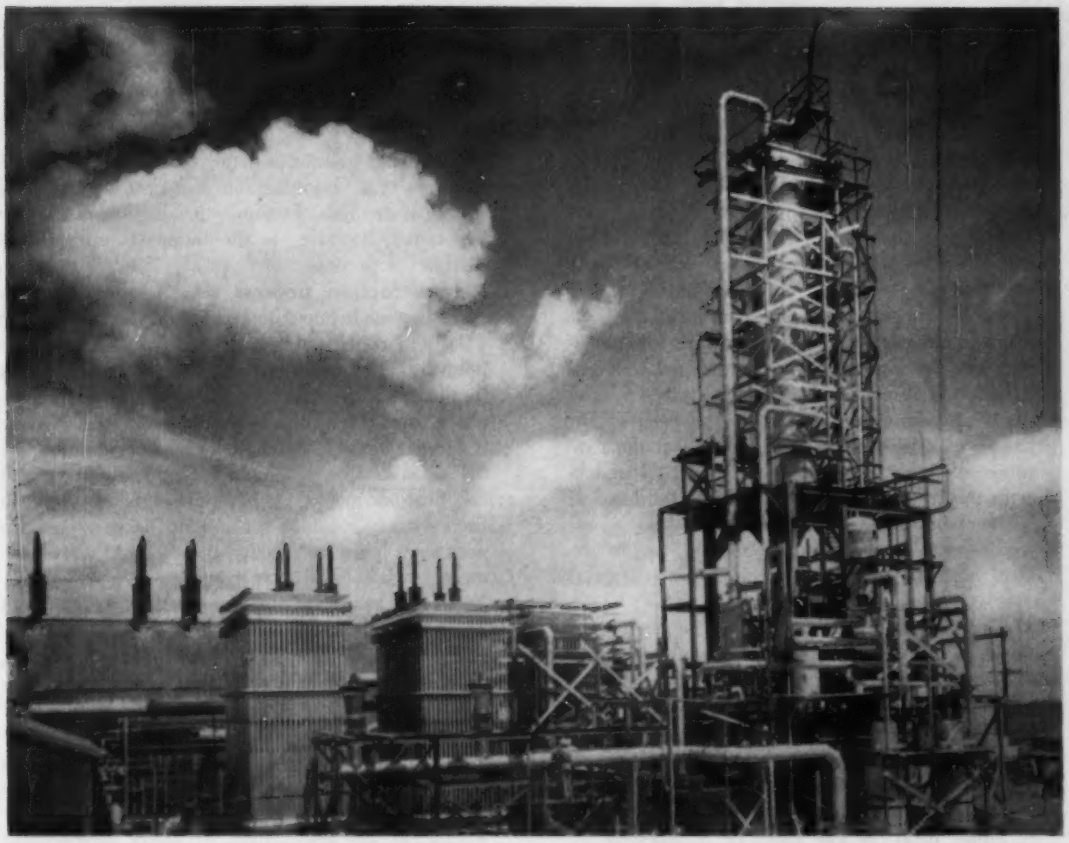
Radiography, perhaps the most-widely used non-destructive-testing tool, literally "sees through" its subject. Steel plate up to 10 in., for example, yields its innermost secrets to this probe. For field inspection where physical limitations prevent use of x-ray equipment, radiography does its job through "pills" of radioactive source material. With research and development producing new and cost-cutting design methods and materials, and test and inspection tools and techniques to prove them, our power-generation and industrial-expansion potential is literally limited only by our imagination.

Nuclear-power application, still very much in the weapons field, is moving slowly but surely into our peacetime way of life. Much of the know-how gained through research for defense purposes will be applied and some of the materials developed will gravitate to our civilian-plant energy systems as quickly as economics will permit. Central-station power generation through nuclear fission is a reality today; industrial-plant application of such facilities is only a question of time.

Insmetals, a new family, are coming down the pike. Originally developed for the U.S. government nuclear facilities, they will soon be available for industrial processes. Not to be confused with materials produced by cladding techniques, these new metals may come into wide use with advent of the nuclear-powered industrial plant. The Insmetals (International Shielding Metals) have high gamma-shielding value. When used in conjunction with borated polyethylene, paraffin waxes, etc, they make reliable composite gamma-neutron shields.

Present use is in complex shielded machinery and equipment of all types throughout the atomic industries: Examples: insect irradiation by the U.S. Dept of Agriculture, reactor shields and spent-fuel chutes required by commercial atomic-power plants, a variety of shielded equipment in nuclear-propelled ships, spent-fuel shipping casks for transport of radioactive elements or fission products. In addition, these metals have high corrosion resistance to many acids, chemicals, petrochemicals and industrial wastes. In industrial energy systems and processes they may find wide application in vessels for containing corrosive media which is or may become radioactive while in service.

Currently there are five International Shielding Metals. They consist of a metallurgically bonded lead surface in various thicknesses combined with (1) aluminum, known as Bauxilum (2) copper—Cupralum (3) carbon steel—Ferrolum (4) stainless steels or nickel alloys—Nicrolum and (5) stainless-clad carbon steels—Ferro-Nicrolum.



CRYOGENIC PLANT for petrochemical installation represents variety of special-purpose systems being built for industry. Use of aluminum alloys for construction of the entire cryogenic system stems from material's good properties at low temperature

CRYOGENICS

. . . a major area for system growth

Industrial cryogenics has been a thriving field for some time, with the handful of liquefied-gas suppliers producing greater tonnages each year. Until recently, gas-liquefaction plants across the country were able to supply the several users in each area by tank car, truck delivery, and in some cases, pipeline. Then the basic research in cryogenics started to pay off. New applications of liquefied gas and increased demand for industrial gases pushed tonnage figures skyward. As a result we now see cryogenic plants like the one above moving into the heart of other manufacturing plants as an integral part. Current or future plans for your industry may well call for incorporation of cryogenic processes, so here's a quick rundown on industrial cryogenics, telling you what it can do for you and what you will have to know about it.

First, what is cryogenics? It usually is defined as the science associated with production of very low temperatures. To engineers in the gas-liquefaction business, "very low" means below the boiling point of N_2O, of about –125 F. To scientists, "very low" usually means below the boiling point of H_2, or about –425 F. In describing applications to plant energy systems we will keep to the range of –125 F or lower. We also will consider all processes from the point of creating a physical change in a gas, liquid or solid, or transporting the gas, liquid or solid within your plant.

Industrial applications of cryogenics stem from two basic process needs: bulk production of gas, and actual use of the low-temperature level. Example of bulk gas production: one major steel manufacturer is just completing a cryogenic installation within his main plant. Unit will supply about 700 tons of oxygen per day to open-hearth furnaces. Steel-mill engineers say they could use about 1500 tons per day if O_2 were used everywhere possible. Tonnages in this magnitude could not possibly be shipped in from area liquefaction plants.

Low temperatures are not new to the food industry, but a recent development in food-product

Industrial applications use low temperature directly or use cold

freezing goes to a new low, using liquid nitrogen at –320 F to quick-freeze cooked produce in a matter of minutes. Evaporated nitrogen is reliquefied in a packaged cryogenic unit. This application could put every energy-systems engineer associated with frozen-food plants into the cryogenic field.

Metal treating at low temperatures offers some distinctive advantages. Low-temperature soaking of some metal castings improves dimensional stability. Cold-working some metals at temperatures around –320 F also improves mechanical properties. For example, stainless-steel sheet hardening at the temperature of liquid nitrogen requires a 10% reduction in thickness. To achieve the same hardness at room temperature, a 60% reduction would be required. Other low-temperature soaking operations control grain structure and precipitation in special alloys.

Hydrocarbon liquefaction can be put to use in many ways. One major area involves storing and transporting natural gas—gas producers are investigating economic feasibility of liquefying gas at the well head. This would probably be accomplished by expansion through turbines or engines, with a compression cycle handling the portion not liquefied on the first pass.

In liquid form the gas could be transported by barge or ship to areas the pipeline doesn't reach. Or as an alternate to pressurized pipelines, liquefied gas at low pressure could be pumped through insulated lines. Power for reliquefying could come from a gas turbine run on evaporated gas. Booster stations would be primarily coolers, rather than the compressors we use now.

Probably the first major use of cryogenics in gas transportation will occur at the delivery end of the line. Several public utilities are investigating liquefied-gas storage as an answer to peaking problems. They're talking about liquefying at the storage point, rather than transmitting liquid gas.

Hydrogen separation by low temperature has been used with coke-oven gas or hydrogen-methane mixture as the raw material. Hydrogen is stripped from methane by fractionation to produce pure gas as a chemical base. Coke-oven gas contains hydrogen and carbon monoxide in a mix which won't separate under fractionation because the two gases have little difference in boiling point; in this case a liquid-nitrogen wash removes the CO_2. Since the resulting hydrogen is contaminated by nitrogen, recent developments aim at purifying hydrogen without resorting to the washing technique. Liquefied hydrogen requires more refrigeration than pure liquefaction would need because an unstable form of hydrogen, orthohydrogen, transforms to stable parahydrogen and liberates considerable heat.

Production methods vary with desired end product and quantities required. Where end product is a gas, liquefaction competes with several chemical methods. Foremost production method in use today, however, is the liquefaction-fractional-distillation process.

Liquefaction process takes atmospheric air, excluding such impurities as water vapor, dust and CO_2, and cools it down to –312.7 F. At this temperature, the gas mixture which is air becomes liquid. Since the various components of our atmosphere are not chemically combined, and also have different boiling points, physical separation of the gases can be accomplished by distillation and rectification means. This division takes place in fractionating columns much like the ones used in petroleum refining. Aside from separation of the major components oxygen and nitrogen, the so-called rare gases—argon, neon, helium, krypton and zenon are collected.

Through careful control of fractionation process, gas purity can be held at desired levels. Normal industrial purity for oxygen runs above 99.5%. For industrial purposes, nitrogen may contain from 0.3% to less than 0.002% oxygen, depending on prepurification or other cleaning operations. Basic cycles are shown at right. There are others used for special process applications or under development at various labs.

High-pressure process takes clean dry air, compresses to 3000 psi, cools and filters, then further cools by extracting work. Towers function as gas-liquid separation systems for oxygen and nitrogen, as well as stripping out portion of air rich in rare gases.

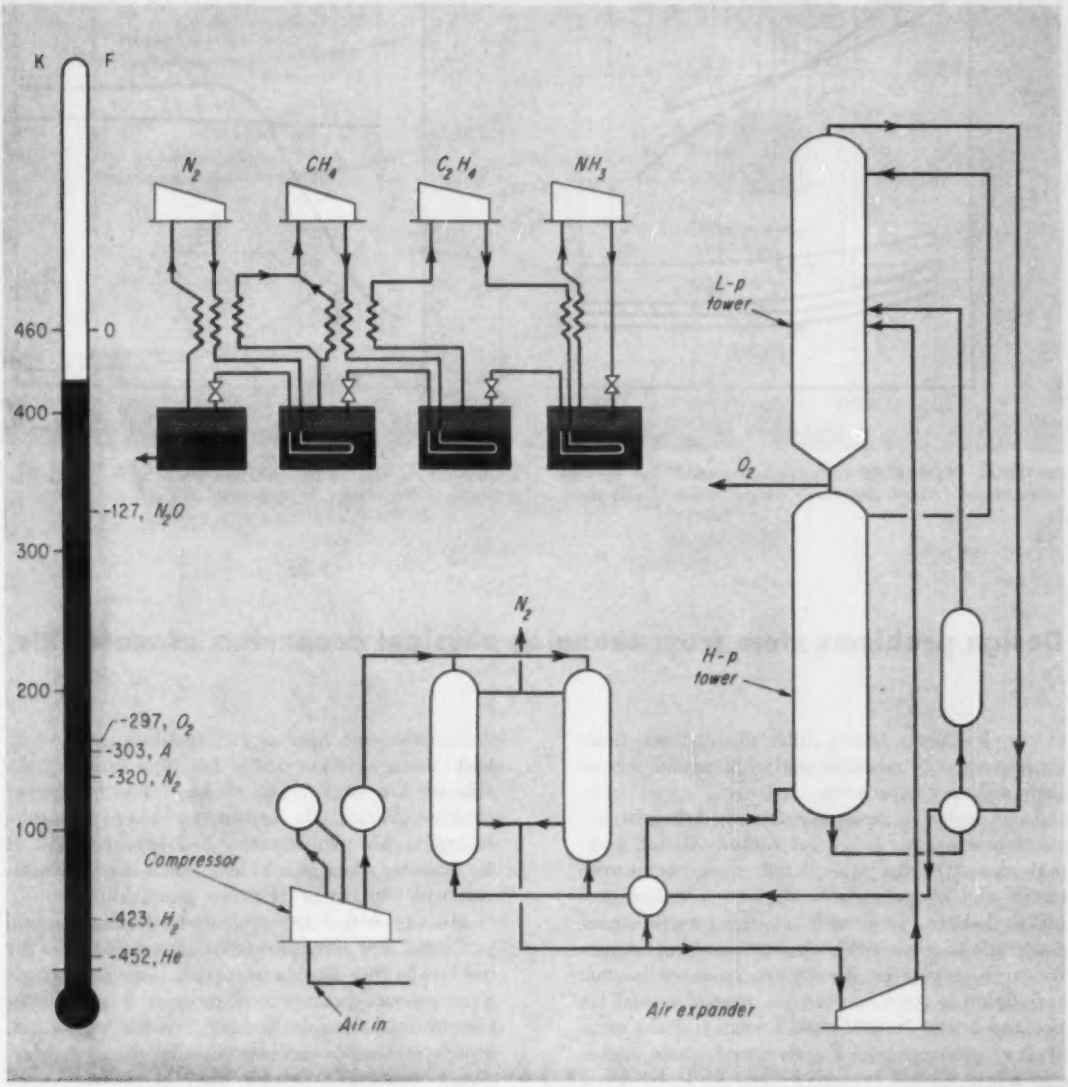
Oxygen usually is distilled in double columns of the type shown, right. Lower column supplies high-purity nitrogen liquid for reflux in the upper column. Prime purpose: separation of oxygen and nitrogen into high-purity streams. But columns inherently tend to concentrate rare gases. Argon remains with the liquid oxygen in the upper column, concentrating at about midpoint of column. Drawing off argon-rich gas from this point, separation in two stages produces pure argon. Stage one removes nitrogen from the mixture by straight distillation. Oxygen is pulled out by combustion followed by removal of combustion products or by selective adsorption in filter beds.

Krypton and xenon remain in the oxygen stream. They are recovered in a separate fractionation column and purified by differential adsorption.

Other rare gases such as neon and helium have boiling points lower than nitrogen; they remain as gases in the condenser. To maintain condenser efficiency these noncondensable gases are removed and separated by distillation or adsorption.

Other processes see some service in specific ap-

to separate gases for purification, production of raw material

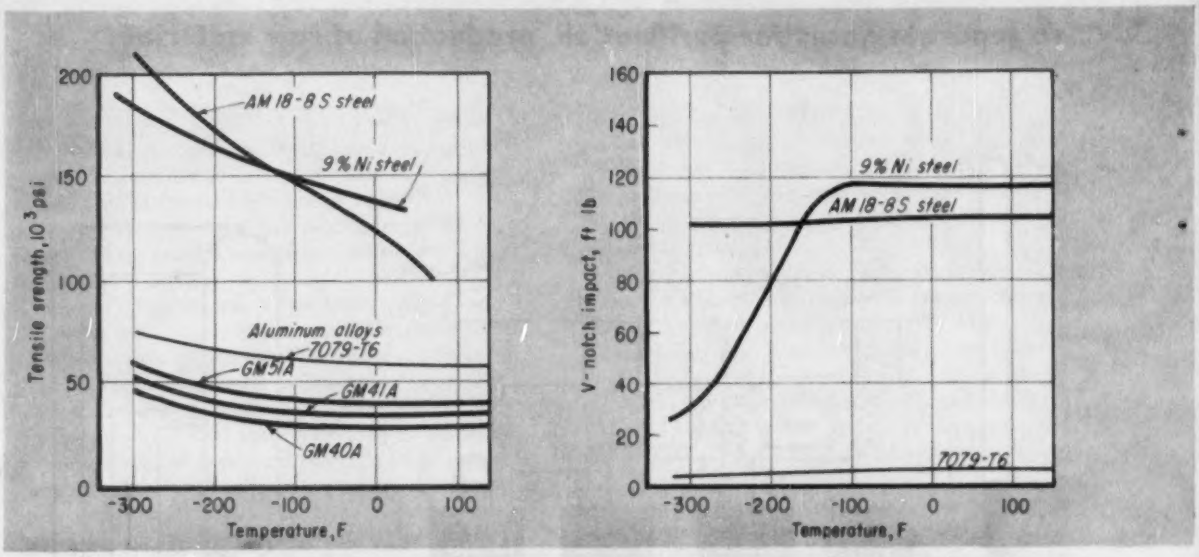


GAS-LIQUEFACTION cycles combine compression and expansion processes with fractionation to liquefy, separate gases. Boiling-point difference supplies key to basic separation. Added steps outside liquefaction cycle further purify the rare gas

plications. Straight Hampson cycle consists of compressor, counterflow heat exchanger and Joule-Thomson cooling. Cooling occurs as compressed gas expands through a nozzle. Under correct temperature and pressure conditions, temperature falls as pressure drops through the nozzle. At one time the Joule-Thomson expansion system was the sole means of producing cryogenic temperatures. Today it combines with expansion engine or turbine. And sometimes it also combines with conventional refrigeration equipment for top economy.

Cascaded refrigeration systems may handle many cryogenic problems. Computed power consumption for cascaded systems can be much lower than achieved by any other basic process; calculations for cascaded air-liquefaction system using NH_3, C_2H_4, CH_4 in series as refrigerants show power consumptions of about 0.2 kwhr per lb of product. Separation of liquid components would still use fractionation tower or other means.

Design problems of cryogenic systems make this a special field. Physical properties of materials



MATERIAL PROPERTIES often change radically at very low temperatures. Aluminum alloy's tensile strength actually increases with decreasing temperature, while ductility remains satisfactory. Stainless steels also fare well at low temperature

Design problems stem from changing physical properties of materials;

at very low temperatures differ so drastically from those commonly met that engineers cannot rely on their ordinary experience.

Some materials become extremely brittle at low temperatures—this is true of carbon steel and several more. On the other hand, many nonferrous metals and alloys such as aluminum, copper and nickel behave very well at low temperatures. Austenitic stainless steels also are good performers. Research engineers discovered quite early that correlation is good between the type of crystal lattice and brittle or nonbrittle behavior of the metal at low temperatures. Face-centered cubic metals and alloys do not become brittle, while body-centered cubic metals do.

Higher strength of aluminum and copper at low temperatures permits use for piping and major components such as equipment in the all-aluminum oxygen plant, p 75. Tensile-strength curves, above, indicate improved properties of aluminum at low temperatures.

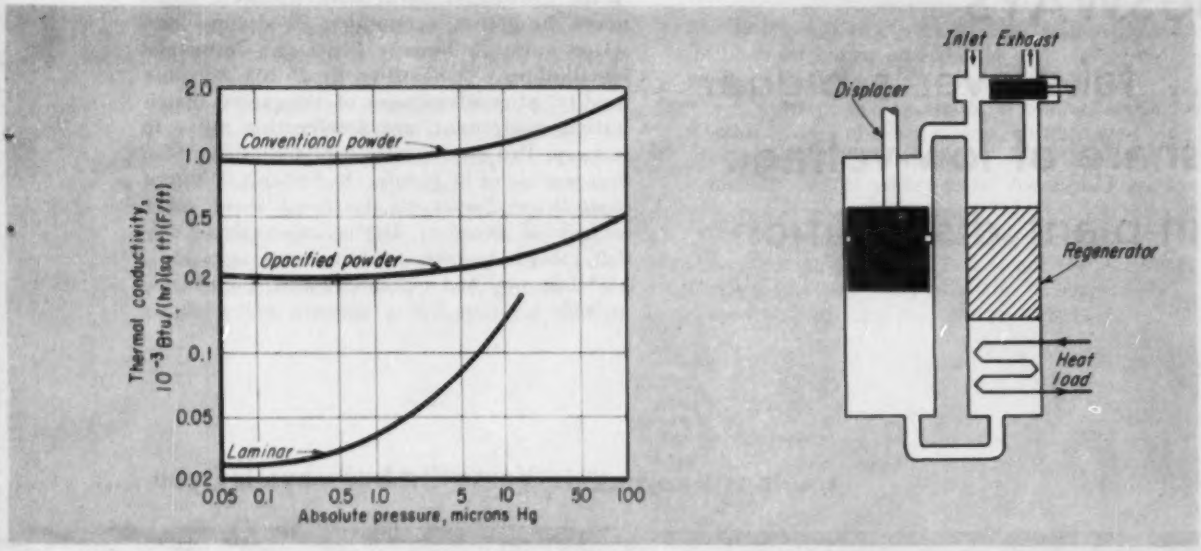
Materials with ductile behavior throughout the temperature range of intended application are, of course, most trustworthy. In these, a minor local imperfection or other stress raiser is unlikely to cause failure because plastic deformation steps in to relieve the stress. This is particularly true for pressure vessels or other structures not subjected to sudden loads. In structural components which may undergo shock loading, examine impact strength.

Plastics may have some applications in low-temperature systems. But so far, little data is available on low-temperature mechanical properties of plastics—particularly brittleness. They are quite strong at low temperatures and may be used if temperature shock is avoided. Teflon is only plastic somewhat ductile at very low temperature.

Heat-transfer calculations introduce several problems. For example, heats of vaporization for the low-boiling liquids are quite low. This means a very small heat pickup through insulation or pumpwork may cause flashing. Specific heats of all liquids and solids decrease with decreasing temperature, becoming extremely small at very low temperatures. Under these circumstances minor secondary effects which you'd normally ignore contribute greatly to total specific heat.

Thermal conductivity of most pure metals and monocrystalline solids increases greatly at low temperatures, to a maximum which may be several times the room-temperature value. At the same time, most alloys exhibit a progressive decrease of thermal conductivity with decreasing temperature. Thermal conductivity of all materials approaches zero as temperature comes near absolute zero.

Thermal insulation almost invariably calls for high-vacuum techniques. Evacuating space between cold container and its outer shell cuts both conduction and convection losses. This leaves radiation as the major problem, and since heat transfer



THERMAL INSULATION usually combines high vacuum with radiant shielding, fine opaque powders or laminar insulation

STIRLING CYCLE gets new lease on life for low-temperature refrigeration. Closed cycle shown here conserves rare helium

solutions use new materials as well as new process cycles

from this source varies as the difference in the fourth powers of the absolute temperatures, every possible means of shielding is put to use. Shielding usually takes three forms: (1) spaced, reflective sheets, (2) powdered insulation which has been opacified or mixed with aluminum powder, (3) laminar insulation, up to 80 layers per in. of reflective aluminum foil alternated with glass cloth. For years, transparent powdered insulation has been standard filler for the evacuated space. New opacified powders are four times better as insulation, and the new laminar insulation about 28 times more effective than conventional powders. We're talking about conductivities of 0.025×10^{-3} Btu/hr sq ft F/ft for the new laminar insulation contained in space evacuated to 0.5-microns Hg.

Instrumentation and control of processes is a major concern in cryogenic engineering since much conventional equipment cannot handle the low temperatures involved. Control valves can be a problem; special construction is required to reduce heat losses as well as handle liquefied gases. Usual designs are modified to stretch valve stems or otherwise cut conduction heat losses.

Flow control is further complicated by problems involved in getting accurate flow measurements. In many cases weigh tanks serve as the base flow-measuring devices.

Temperature elements for industrial cryogenics are familiar in operation, new in precision. Most popular unit is the gas-filled bulb, with thermocouples handling many jobs—particularly where information is needed only as a difference between two temperatures. For very-low temperatures, resistance thermometers supply high accuracy and easy recalibration. At low temperatures frequent recalibration is a must, so resistance elements have a major advantage here. For more on low-temperature measurements, see POWER's up-coming article on performance-testing cryogenic equipment.

Future use of cryogenics in industry will probably force plant capacities higher and higher. At the same time, opportunities for using small packaged cryogenic refrigerators in electronics and biochemistry should mushroom. We can look forward to new refrigeration units and cycles, using hydrogen or helium as the working fluid in a closed cycle. A prime example of this: the pint-sized unit developed by Arthur D Little, Inc. Operating on a modified Stirling cycle, one model uses helium at 300 psi to produce temperatures of 50 K. A larger system developed in Europe uses the same basic Stirling cycle to produce 170,000 Btu per hr of cooling at 77 K. These units are expected to see service in air-liquefaction plants.

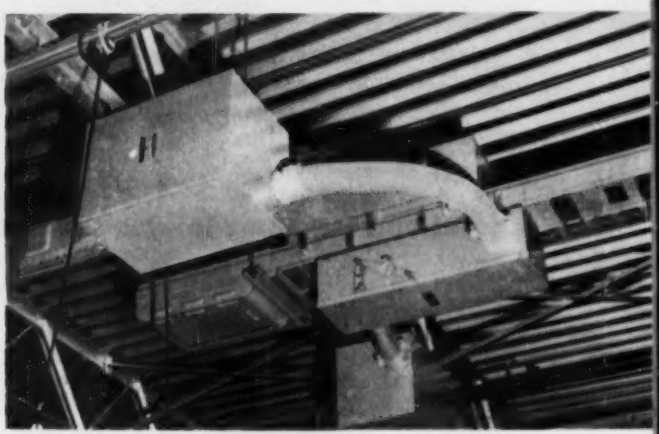
Cryogenics has grown from laboratory toy to specialized science to standard industrial process. Soon it will become another effective field of design operation and maintenance for the energy-systems engineer.

BUSWAYS

. . . take over a bigger share of low-voltage in-plant distribution

With growth of local concentration, engineers find that economies in dollars and space point to busway for many industrial installations. Versatility, flexibility, salvable quality, plus advantages of integrated distribution equipment, are accelerating move to busway. This doesn't mean wire and cable are on their way out of l-v picture. As POWER's *Industrial Plant Design Survey* (in this issue) shows, other methods of secondary distribution—cable in conduit, cable in troughs, interlocked armored cable—hold their own. And applications where one of these methods is preferable to busways will continue;

Versatile busways let you . . .



BUSWAY TYPES serve different needs: feeders (shown flat), plug-in for power (on edge), lighting (with cords attached)

POWER's editorial program, Power to Grow . . . *electrically*, was begun in 1956 to promote planning for system growth with minimum initial investment. A major plug-in busway installation was takeoff point for article (August 1957) on planning for changing loads. Flexibility and expansibility are inherent in busway distribution systems. Taps can be easily added or altered when load shift requires, and new sections are readily integrated into the system. Busway can be salvaged when relocating.

Today's busway isn't just another electric conductor, it's a complete distribution system. Components include not only the bus-bar sections, but circuit breakers, fused switches and lighting panels. According to NEMA definition, "a busway is a prefabricated electric-distribution system consisting of bus bars in a protective enclosure together with associated fittings". Fittings are available today in great variety, all designed to make installation of busway possible and most economical under differing conditions in industrial plants.

Installed cost: busway is competitive

Prime objective of busway (although it has many other benefits): cut installation manhours to the bone. Work is done in maker's factory at high efficiency, not in your plant. Installation problems which may be encountered are predicted by manufacturer, provided for when he designs his fittings.

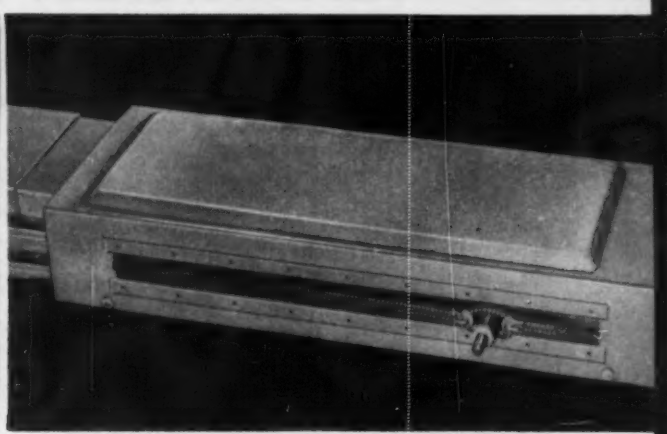
both engineering and economic factors will differ.

In medium-voltage area of primary distribution (above 600 volts through 15 kv), busway is not yet in the picture. In fact, though some busway engineers predict its eventual use, they agree m-v distribution bus isn't likely to be available for some time. But it does appear to have a future in large commercial buildings where space is always an important consideration. Practical ampere capacity of 460-v bus may be exceeded in some engineers' opinions. Such a m-v bus could feed substations with dry transformers at several levels of the building. Subs would be easily connected, perhaps plugged into the medium- and l-v busway systems.

Improvements in wire and cable since POWER's *Today's development* report in April 1958 are reviewed on p 84. While there are no outstanding new developments to report, steady betterment of existing types of cable, especially with respect to insulating materials, offers the widest choice yet to meet tricky job requirements. *Industrial-Plant Design Survey* points up greater use of m-v aerial and interlocked-armored cable. Direct cable burial in larger industrial plants is a trend, say some engineers consulted. Conduit retains its supporters; interest in corrosion-resistant types is lively.

. . . solve a variety of tricky distribution problems

INSTALLING PLUGS in limited space is simple and safe. Transition to wire and cable can be made with end tap shown



ADJUSTABLE LENGTH, from 36 to 48 in., fits busway to exact dimensions of application. Tandem zippers keep it closed

Present array of fittings and devices can probably give you the distribution system you want without any time-consuming special adaptations. In many cases busway proves to cost less than cable in conduit when total cost of installation is tallied.

Types match function

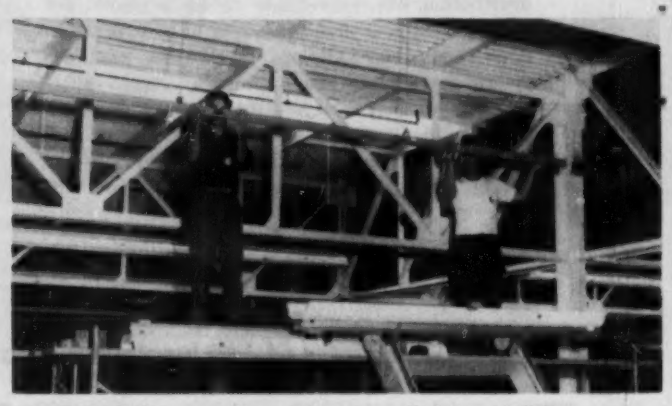
By NEMA definition busways are either *feeder* or *plug-in*. "A feeder busway is a busway having no plug-in openings and intended primarily for conducting electric power from the source of supply to centers of distribution . . . a plug-in busway is a busway having plug-in openings on one or both sides at spaced intervals, offering means for electrical connection of plug-in devices to the bus bars." Additions to these are *lighting* type busway, which you can plug into anywhere along its length through a slot in its underside, and *trolley* bus. With trolley, plug may be moved to any location along length of bus during operation. This type is used for cranes and hoists, portable tools and test equipment. A combination feeder-plug-in busway is available with current ratings from 600 to 4000 amp, 600 volts or less, in 3- or 4-pole designs.

While most busway is designed for low voltage drop, certain types are intended to be current limiting and have built-in impedance. Widest use is in commercial buildings where you want to reduce available short-circuit current values so you can use standard protective and distribution components. And it finds growing use for feeding industrial motor-control centers—25,000 or 50,000 amperes available on 800- or 1000-amp runs—underscore desirability of keeping short-circuit currents down to reasonable values by some impedance.

Latest variety of plug-in busway in 225-to-1000-amp class has lower impedance, lighter weight and smaller size than older forms. Important feature:

Rolling in lighting busway and

Installation at AC Spark Plug plant, Flint, Mich. is latest of several roll-in jobs. Installed by Universal Electric Co, busway was pushed into the hangers rather than pulled as in earlier jobs—effective



Elevator lifts busway section, fixtures to work platform . . . where sections are rolled through first

continuous butyl bar insulation reduces distance between bars. Bars are flattened tubes with hollow construction or welded strips. Both approaches make possible use of small-sized plug fingers (stabs) which fit through small openings in butyl cover. Object is to achieve dead-front safety.

Joints are made with a single bolt and combination of insulators. Bolt head is outside duct. Pressure distributes evenly between the conductors, and Bellville springs permit movement to compensate for differential expansion between bus bars and housing. Insulators are glass-filled polyester. Joint can be safely tightened without de-energizing the busway system. As many as 12 power-tap-off outlets per 10-ft section can see simultaneous use. Short-circuit rating: 50,000-amp-rms asymmetrical for 400-to-1000-amp bus.

Safety is emphasized in busway described; particular features depend on the manufacturer. Plugs are designed to prevent installation or removal when plug handle is in the ON position. Outlets are polarized so plugs can't be inserted incorrectly. Another safety feature in some designs: outlet cover can't be opened until plug is positioned in front of the outlet. Then inserting a key or interlock on the plug into the busway enclosure releases the cover, lets you slide it out of the way. Positioned plug is then inserted.

And check these further advantages

In addition to initial ease of installation, plug-in busway easily adds or removes branches as load shifts. In fact, this feature often tips the scale in favor of bus. Up to 5000 amps, busway takes less space and weighs less than a cable-in-conduit system. It is easily rearranged—a system-flexibility bonus—and fully salvable in case of relocation and reuse. Advantages claimed, but more difficult to prove, are greater safety, reliability and longer life compared with cable. Some manufacturers point out that it *looks* more modern, and this can be a factor in some circumstances.

Construction solves problems

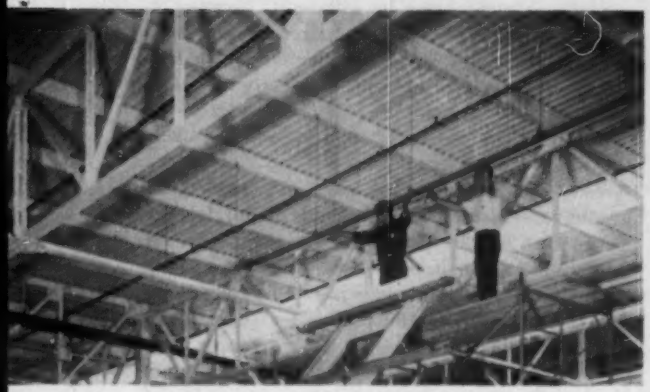
Bus bar is either alumnium or copper; aluminum gets the nod in increasing number of applications. It's cheaper, lighter, and being plentiful it's more readily available. Larger dimensions than needed for copper don't often count against it. General practice is to silverplate aluminum bus bar for its full length, eliminating chance of galvanic corrosion at boundary between metals in presence of moisture and contaminants. The silver is actually top layer of multiple plating, usually zinc, copper, silver. Some engineers recommend corrosion-resistant aluminum for atmospheres containing sulfur dioxide or hydrogen sulfide.

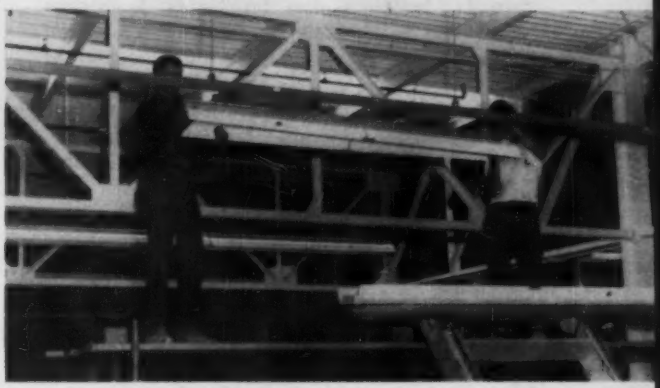
Single or multiple bars may be used per pole. Multiple conductors are brought together at joints. Feeder busway has bars individually bolted at junctions, insulated throughout their length. In lighting busway, tubular conductors are supported by molded insulators at frequent intervals. Electrical connections are made by spring connectors inserted in conductors at the joints.

Successful application of busway is made possible by array of fittings and bolt-on or plug-in compatible equipment, as system at right shows.

hanging fixtures from one place at one time save many manhours

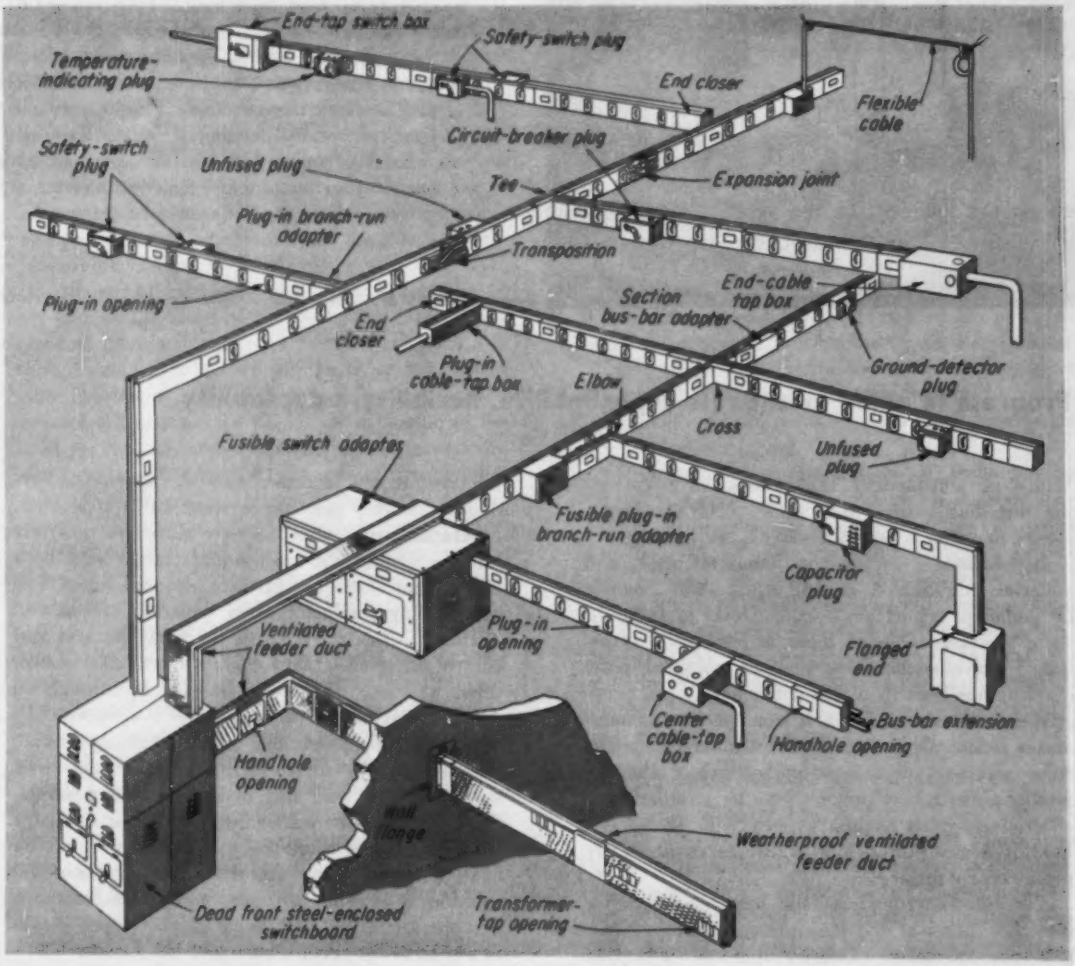
further simplification. Hangers are installed first, held rigid by fastening to lateral rod. Each hanger has two rollers; they fit into slots along upper edge of duct sides and support it. Attachment on first section serves as "needle", guides duct into hangers. As each new section is coupled and fixtures attached, entire busway is pushed farther down plant's length through successive hangers.





. . . hangers and coupled to already-hanging sections. . . . With fixtures attached, section is rolled along

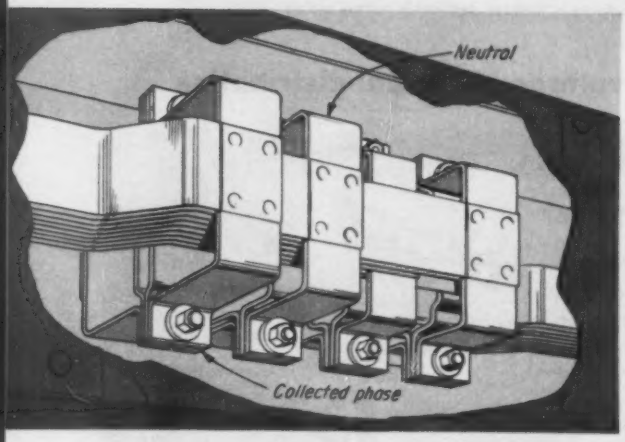
Busway system: complete low-voltage electrical distribution



Busway meets challenges of higher-frequency distribution

Applications for alternating current at frequencies higher than 60 cycles are increasing in number and capacity. Industrial uses for higher frequencies were listed in POWER's special report, *Electrical Conversion*, December 1959. Aircraft and allied industries are major users today. High-speed tools and fluorescent lighting are important in other industries. Lighting promises big future expansion, but it's not yet predictable how extensive distribution systems will need to be.

Load concentrations and other considerations have led to centralized conversion equipment and plant distribution at higher frequency. Experience in developing a 400-cps system of over 1500 kva was described in POWER, April 1960.



←**CLOSE SPACING,** transposition are keys to low reactance

For low voltage, busways appear to be more practical. Standard 60-cycle busway can be used successfully in many cases by sufficiently derating it. Several manufacturers, however, recently developed busway specifically for h-f distribution which simplifies problems in plants with large-capacity, finely regulated, low-harmonic and quick-response power demands. High-frequency applications are likely to be high quality, too.

Voltage drop, inductive losses and consequent heating are more severe problems in h-f busway design than at 60 cycles. Low or varying power factor and load unbalance have more aggravating effects. One type of busway is rated at not more than 1-volt drop per 100 ft, line to neutral, with equally distributed load and at least favorable value on pf curve. Normal voltage rating is 600, but higher ratings are obtainable. Ampere ratings of 600 amp or higher can be had.

Reactance is minimized by close spacing of bars which is maintained even at the plug-in openings. Bars are covered full length with insulation such as polyvinyl-chloride tubing. Plug-in contact is made through insulated openings in the bus bars. Phase collection and transposition contribute to low impedance. Complete phase transposition occurs at end of every three sections. Phases are collected at joints to equally distribute current. Bars may be aluminum or copper with steel or aluminum covers. There are four plug-ins per ten feet. Variety of fittings resembles typical 60-cycle counterparts.

Progress in cable extends its dependability, flexibility, adaptability

While no outstanding innovations have entered the distribution-wire and -cable picture recently, steady progress is reported along some lines.

Insulation is getting continuous attention, and materials highlighted in our April 1958 *Today's Development* report are coming closer to fulfilling their promises. One of these is chemically crosslinked polyethylene. Low melting point of polyethylene has been its major deficiency. When properly crosslinked and filled, it won't melt at temperatures below about 300 C. Crosslinking its molecules makes it thermosetting instead of thermoplastic. Crosslinking polyethylene by irradiation is effective on small hookup wires (16 to 30 AWG), but for heavy power-cable walls it's economically prohibitive at present.

Varnished-dacron-glass tape has more superior electrical, physical and moisture-absorption properties than varnished cambric. Reduced insulation thickness makes increased current capacity and reduced diameter possible in some cable types.

Aluminum conductors have moved more firmly into the picture and most manufacturers offer both copper and aluminum in their standard lines. New copper-alloy conductor gives remarkably increased flexing life to electric cords for portable tools and control circuits. A 600-v cord, it's available in two, three, and four conductors in sizes 18 through 10 AWG. Insulation is rubber; jacket is neoprene.

Aluminum-sheathed cable is slowly gaining ground. It has markedly increased mechanical ruggedness compared with lead and, of course, lighter weight. Since it needn't be pulled into conduit or ducts for protection, it is more-readily applied to building contours. In conjunction with silicone-rubber insulation, it is suited to high ambient temperatures, can operate at 200 C in some cases. Copper sheath is available for certain corrosive conditions.

LUBRICATION ...for tough loads on gears, bearings gets fresh thinking

For many years lubrication men have wrestled with the problem of applying heavy—high viscosity—lubricants to bearings. They've also wrestled with, and solved, the problem as it applies to gearing. Recent developments and new thinking are showing their effect today.

A new angle for aerosol

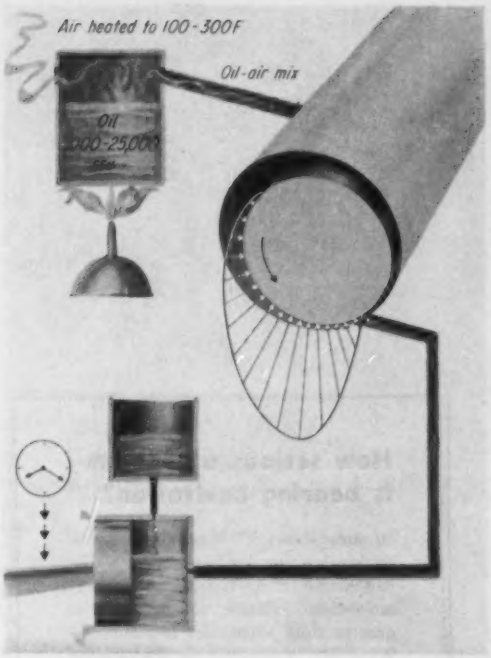
Most recent approach to the heavy-lube-for bearing matter has adopted the air-oil technique. Airborne oil as a lubricating medium is really an application of the time-honored aerosol idea. Aerosol lube systems are generally fully automatic. They have successfully provided a uniform oil flow to groups of bearings originally designed for either oil or grease. Applications: sliding and rolling-contact bearings, rollers, chains and gears.

Principle behind the air-oil mix is simple: atomization of the oil, then distribution of air-in-oil mixture through tubing to bearing surfaces. Moving shaft within the bearing actually knocks oil out of air stream, depositing it as a film between shaft and bearing. Oil separates from the mixture only when it hits moving surfaces.

Aerosol lubricators use a supply of compressed air to pick up drops of oil, feed them into the air stream. Relatively heavy oil particles fall back into the oil supply while very fine particles are pushed into lubricator discharge line. In conventional aerosol lubricators now in service, a portion of the inlet air flows directly through the lubricator without entering oil reservoir. This free air combines with the airborne oil. Some installations have a visible lubricator oil feed to check rate of flow.

Oil-in-air delivered by lubricator has a predetermined particle size. It's this small size that makes it possible to carry the fog through piping for long distances without deposit. For that reason position of the lubricator in relation to the bearing isn't critical. You can readily get uniform lubrication through many bearings from one lubricator.

Latest twist on this oil-air concept makes possible dispensing airborne lube oils in viscosities ranging from 1000 to 25,000 ssu at 100 F. How is it done? Simply by putting a unit heater in the oil reservoir, adding a separate heater to warm incoming air to 300 F. Preheating air permits atomization of heavy lube oils, and heated air then carries atomized oil particles to point of application. External air-to-rod heat exchanger is supplied from a 220-v single-phase source. Thermostatically controlled, it maintains temperature from 100 to 300 F.



NEW APPROACHES to bearing lubrication include (1) a high viscosity oil-air mix (2) timed auxiliary injection of oil into engine bearings to eliminate cavitation problem

Bearing-inches are the arithmetical sum of diameters of all bearings to be served by one lubricator. In early days of aerosol lubrication, typical system could handle up to 20 bearing-inches for plain bearings, 30 for ball or roller bearings. Using the heated-air technique with high-vis oil, you can design for system lubrication up to 500 bearing-inches. This greater capacity, backed up by a 3-gal tank, will generally hold enough oil in reserve to provide a 48-hr week of continuous lubrication for 500 bearing-inches.

Primary advantage of the oil-air technique lies in the fact it is *continuous*—there's a constant supply of uniform volume to each bearing. This wipes out the old feast-or-famine oiling problem. Aerosol lubrication is economical; it's not unusual to find consumption one-tenth other once-through systems.

Where can you use the high-vis oil-air setup? It's designed for a wide variety of applications: shearing and punch presses, larger open gears including bull gears found in cement and steel mills, gear trains, shaker screens.

Spray lube keeps up to date

Of course, all do not agree that aerosol is the last word in gear lubrication. Applying heavy oils using a high-temperature air source is relatively new, and there are many who feel that spray lubrication is probably still the most practical and economical method of lubricating open gearing. In

How serious a problem is bearing cavitation?

In some areas it's a toughie. When engine bearing load comes on a disrupted oil film, transverse journal movement relative to bearing is greater than when film is complete. What oil is present is compressed to a much thinner film. Minimum oil film under peak loading is about half that present in a complete film. And shaft momentum acquired during this transverse movement is greater because the movement is greater, so a higher general pressure is imposed on the bearing.

As cavities collapse under load, spreading fronts of the separate oil film areas meet and produce shock waves. These in turn set up a pattern of additional peak loads over the bearing surface causing fatigue or cavitation damage. Since oil film is thinner a higher rate of film shear occurs. This in itself ups temperature of film and bearing. Result: a decrease in resistance to cyclic loads.

New oil film supplied under the peak loading point reduces the transverse bearing movement and eliminates consequent problems. Glacier Metal Company engineers estimate — conservatively, they say — that auxiliary lube injection means conventionally calculated bearing loads may be uprated by a maximum 50% in load × speed. This factor alone will give the engine designer new freedom: bearings no longer a limiting factor in uprating engines.

What will it cost? From manufacturer's viewpoint, a 20% gain in continuous rating of a 1000-hp diesel engine increases its value by some $11,000. Estimate for a Glacier Ramrod installation: $560.

thumbing through the case-history files of lube-spray manufacturers, you note many jobs where adoption of the automatic spray technique made a sizable cut in lube consumption compared to the drip-or-pour method. From a rather modest beginning, a centralized spray scheme of applying lube has spread to presses, kilns, raw and finishing mills, rubber mills, paper mills plus a wide variety of open gearing in steel mills.

It's true that open gears are gradually passing out of the industrial picture. But there are still thousands of installations and they will see continued service in years to come.

Mechanics of a centralized measured-lube spray system are simple. In operation a set quantity of lubricant is fed to a spray-control valve instead of discharging to a load-bearing surface, as would be the case in a conventional centralized system.

In one scheme the flow of lubricants moves a control piston to open an outlet port to the nozzle; at the same time a check ball is unseated permitting air flow to nozzle. Air and gear lube mix just outside the nozzle tip and form a spray. Once the measured quantity of lubricant is discharged in spray form, device automatically shuts off until the next lubrication cycle. You can design for manual or automatic control of cycles. In this way, with adjustable cycling of system and adjustable metering valves, any desired amount of lubricant can be sprayed onto a gear in any given period.

Question: Where to spray lube

Only a few years back many competent engineers took oath that the ideal spot for spraying lubricants on a gear and pinion was the point of mesh. Experience has taught us different. Actually, air turbulence at the point of mesh, resulting from air ejection of meshing teeth, is often so great that lubricant spray cannot satisfactorily penetrate the backcurrents. Accepted practice today: install the valve so lubricant is applied to pressure side of the gear teeth. General recommendation locates the nozzle six to eight inches from gear, using a 30-deg-angle spray.

Keep in mind that the spray method was not intended to replace conventional schemes. Sure, there are some systems that could spray light oil. In fact, present equipment will handle anything from an engine oil on up to heavy gear lubricants. But main purpose of spraying is to replace drip-and-swab heavy-residual lube on open gearing. In your design work think of this equipment as a gear-coating device. Once the gear is coated, it will run for a period before needing additional lubricant. The spray-lube principle is intermittent, not constant.

Many side benefits go hand in hand with spray lubrication. Case in point: a 40-inch blooming mill in a steel plant where spraying tacky, asphaltic-residual extreme-pressure oil replaced the old method of hand packing the necks with block grease. The switch was an attempt at increasing bearing life so roll changes would be dictated by condition

of work surface of the roll instead of bearing. This was readily done, but side benefits poured in. For instance: improved safety aspect with crew hand-packing eliminated, reduced mill downtime, reduced bearing costs when they stopped using bronze inserts in tin-base babbitt bearings and adopted the lead-base babbitt. And for further incentive . . . even some reduction in lube costs.

One answer to the cavitation problem

There is growing interest, both here and abroad, in unearthing ways to overcome problems associated with bearing cavitation. A somewhat anticipated conclusion was recently reached in England's National Engineering Laboratory. They noted that disruption of oil films by cavitation often occurred in reciprocating-engine bearings. Under the sponsorship of Glacier Metal Company Ltd, a transparent bearing was built that could run at low speeds under oil-film conditions dynamically similar to those of an actual engine bearing.

Transparent test model was made geometrically identical to a large diesel-engine bearing. As they expected, for much of the bearing's loading cycle the oil film was badly disrupted. Cavitation occurred at various points in the cycle and the disrupted oil film moved around the bearing at average oil-film speed—about half the journal speed. Oil film cavitated where journal moved away sharply from bearing.

Next step was to inject lubricant into the bearing clearance space—a fresh, separate volume of oil to fill the space completely. Scheme depended on a positive-displacement ram type pump. Driving speed was selected so volume of oil injected into the bearing would be equivalent to projected area of the bearing times total clearance. Pump supplied the bearing at a pressure high enough to inject this volume over about a 90-deg arc of journal movement *preceding onset of peak load*. This apparently did the trick. Minimum oil-film thickness at end of power stroke was about twice what you'd expect with conventional lubrication.

Tests are going on at present with actual engines. The Glacier people suggest that in many engines, particularly those rated up to 100 hp, this Ramrod system can be most economical when only applied to certain critical bearings. Typical: main bearing adjacent to flywheel. Auxiliary oil injection would superimpose on the normal system. Ramrod pumps may be designed as a unit and driven from end of shaft. Additional cams on engine-valve camshaft might be best solution for smaller engines.

Time available for injection of calculated oil volume is inversely proportional to engine speed. Thus the higher the engine speed, higher will be pressure rise within pump. Work to date indicates that in most cases pump pressure in psi is about equal to, but does not exceed, engine speed in rpm.

Not even the additional hp required for pumping —about .3% of total engine output—is lost. The reason is that there is less frictional loss in bearings when operated in a greater oil-film thickness.

Common tag for like viscosities?

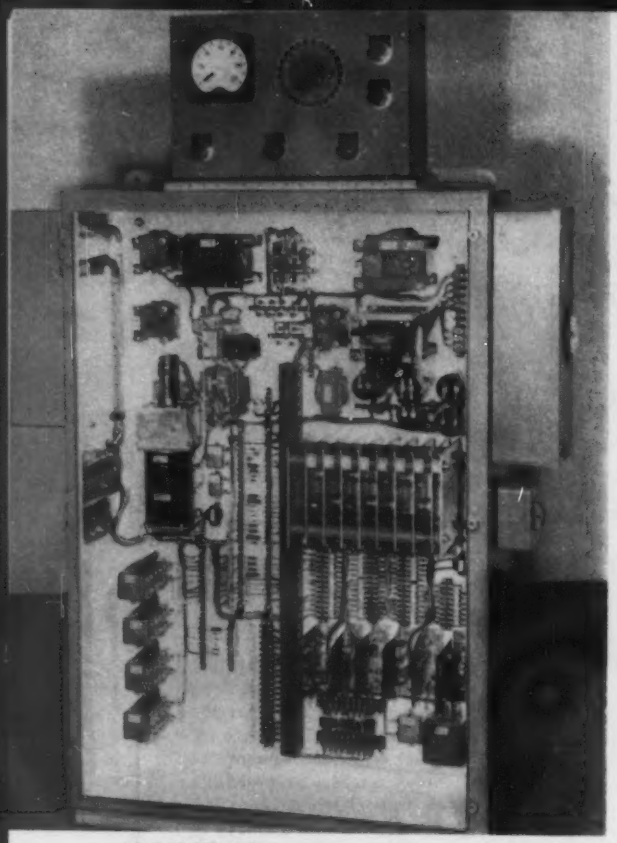
Lubrication engineers, representing general industry and oil suppliers, have been considering for years the feasibility of a new lube-oil-viscosity classification scheme. Without referring to oil quality, proposed industrial-viscosity-classification (IVC) coding would take over in place of present AGMA, ASRE, SAE and government viscosity designations.

IVC 2-digit numbering system paves the way for punch-card purchasing and inventory. Since viscosity doubles every third step and increases tenfold every tenth step, the IVC plan appeals mathematically. The steel industry has successfully latched onto a similar plan, but there are many problems yet to be resolved before we see such a scheme in use across all industry.

During a 1957 summer meeting of ASTM in Atlantic City, interested parties were given a chance to air their views on simplified viscosity classification for industrial lubes (POWER, Aug 1957, pp 71-74).

Prior to that meeting, IVC proponents repeatedly pointed out that in none of the individual or joint studies made was there an attempt to deal with matters of viscosity index, viscosity-pressure effects, oxidation stability or any other properties of a lubricant. They proposed that individual industrial groups such as the ASRE and AGMA, who had established viscosity standards for their own interests, could adopt a national standard.

In the intervening three years, many meetings have been held and new proposals come to the fore, but with no tangible progress.



SELF-CONTAINED computer control can be programmed for several speeds. Dial reads speed or production units

CONTROL ...for steam turbines adopts a brand-new concept: electric-hydraulic governing

Advent of fully automatic central stations and need for better wide-range speed control in mechanical-drive machines have brought about a fresh concept, a supersensitive steam-turbine governor. Its basic components: (1) electric speed-sensing device (2) solid-state computer (3) electric-hydraulic transducer (4) hydraulic valve positioner. Past efforts at electric speed control of steam turbines gave mixed results—reliability left something to be desired, governors were complex and electronic components fragile. But solid-state computers eliminate these shortcomings. Reliability is high, units rugged and simple. In fact, latest arrangements are merely new combinations of tried-and-true components.

Many of these basic principles apply also to diesel- and hydroelectric generation, anticipating speed change by sensing load change directly.

Naturally, first electric-hydraulic governors for steam turbines have gone to work where need is greatest—paper-machine drives and auto-extraction turbine-generators. In some cases paper-machine drives have been difficult to control to the satisfaction of operators. Speed control in lower ranges has never been acceptable. Auto-extraction machines in industry have necessarily been complex and subject to upset; a rapid and wide steam load swing has tended to upset the electric side, and vice versa. But electric-hydraulic governing puts these difficulties into the history books.

NEMA Standards for paper-machine drives require turbine's speed control to be ±0.25% of rated speed. Manufacturers have bettered this to ±0.10%. Now, electric-hydraulic governing adds its further refinement: ±0.10% of *any operating speed*. This difference is a big factor where variable operating speeds are a must—again, take paper-machine drives as a case in point.

Hardware varies among manufacturers, but basic concept is fairly constant. A trip through the governing system would run something like this:

(1) Speed-sensing device is electric. Its output may be analog—from a tachometer generator—or digital—from a counter. Digital design uses a variable-reluctance pickup accurate to 5000 cps to count flux changes from a rotating notched wheel or toothed gear on the turbine shaft. Output from either sensing device is usually amplified before next step, digital signal converted to analog.

(2) Solid-state computer receives signal from sensing device, compares it with a preset standard and signals transducer. Other signals such as load or steam flow can also be fed to the computer for additional control. Electrical feedback stabilizes and compensates computer output.

(3) Electric-hydraulic transducer converts computer's electric output to hydraulic force for speed control. In auto-extraction machines or turbines in parallel, several transducers—one or more at each turbine—can be controlled by one computer.

(4) Hydraulic valve positioner is conventional or more sophisticated in specific applications.

Next application step for electric-hydraulic steam-turbine governing will be in fully automatic central stations. Here the solid-state computer will provide an ideal place for electric input to program startup and shutdown. It will accurately control low operating speeds, far below capability of normal fully hydraulic governors.

Within the next few years, electric-hydraulic governing of steam turbines will probably spread throughout the large-m-d turbine area, see service in compressors for petrochemicals, and feed pumps for automated central stations. Most likely its only limitation will be economics, confining application to the larger multistage, multiport types.

Power OCTOBER **1960**

Industrial Plant Design Survey

Design features listed on the following pages are from newly completed or modernized industrial plants, from some still under construction, others yet on the drawing board. The term *industrial plant*, as used here, includes commercial and government buildings, hotels; in brief, sizeable non-central-station installations. Survey covers three significant energy-systems areas: *electrical distribution, steam generation, air conditioning.*

The electrical-distribution report is the third of its kind to appear in print; the first appeared in POWER, Oct 1958. It includes electrical detail right from the incoming main or primary sub through circuitry to lighting and motor loads. For the second year running, the three pages of air-conditioning tables list important features found in typical modern installations.

But because of the way we must compile facts the survey has its limits. We started the job by listing installations planned or on order. Then we sent questionnaires to individuals closely allied with each project asking for details. Replies went into the tables. So, by the very nature of things, you can see that these tabulations can't be complete. But they're representative of current design and construction, so you get timely information on trends.

Once again: these are not complete lists, but extensive samples. Don't use the survey to get total values or where incompleteness may distort results.

1960 electrical - systems design survey:

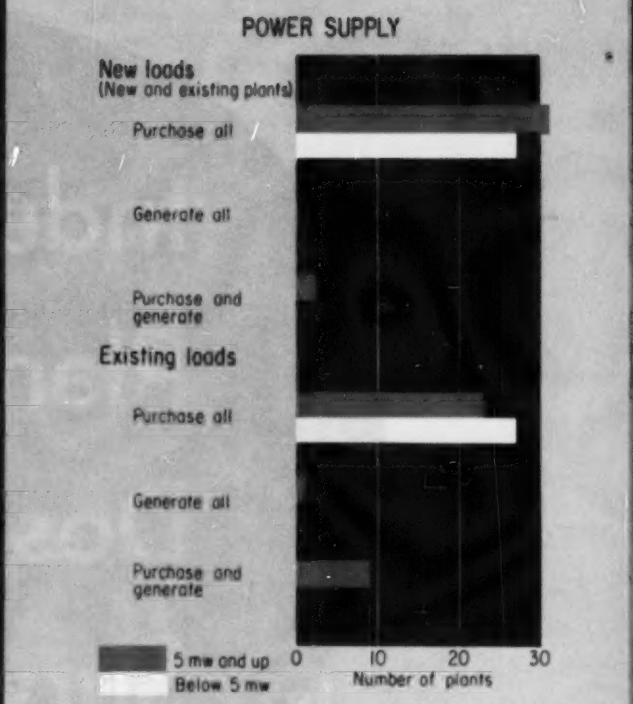
DISTRIBUTION TRENDS

- Self-generation shows marked decline
- Customer-owned main subs in majority
- Meter location about evenly divided
- Dry transformers lead in secondary subs

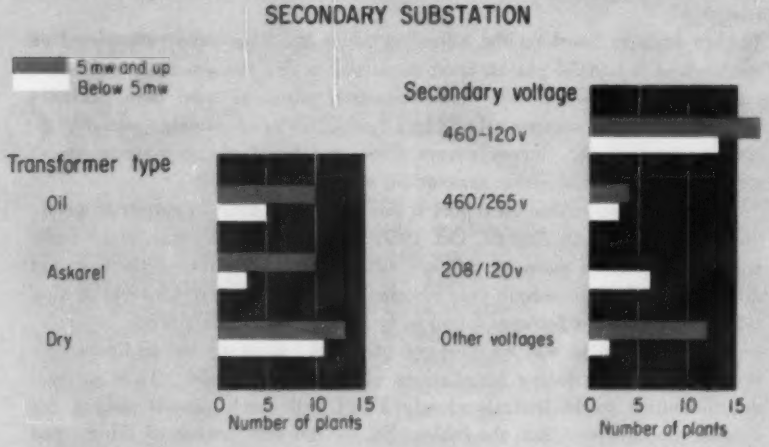
Design features of electrical-distribution systems in the 60 plants surveyed are summarized on these pages. Tabulation of pertinent data begins on following pages. Although but a relatively small sampling is represented here, it may be considered typical of current practice.

Data in the summaries divide into two groups, based on plant's electrical size: five mw is the dividing line. Hence the double bar charts. Example: self-ownership of main (primary) substation is nearly twice as frequent among plants of five mw or more as among plants of less than five mw. Size of plant usually has influence.

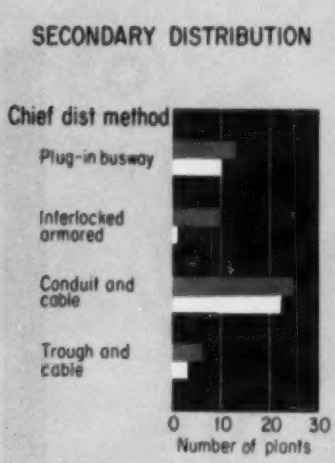
When interpreting trends from these summaries, check tables for influencing factors. Number of plants generating electricity as shown by the bar charts, for example, doesn't by itself indicate magnitude of the generator-fed load. Nature of the manufacturing process would be a consideration. Comparison with last year's summaries will help you to interpret trends in distribution.



SELF-GENERATION capacity, other than emergency or testing, has increased in only two plants surveyed; no new plants generate all



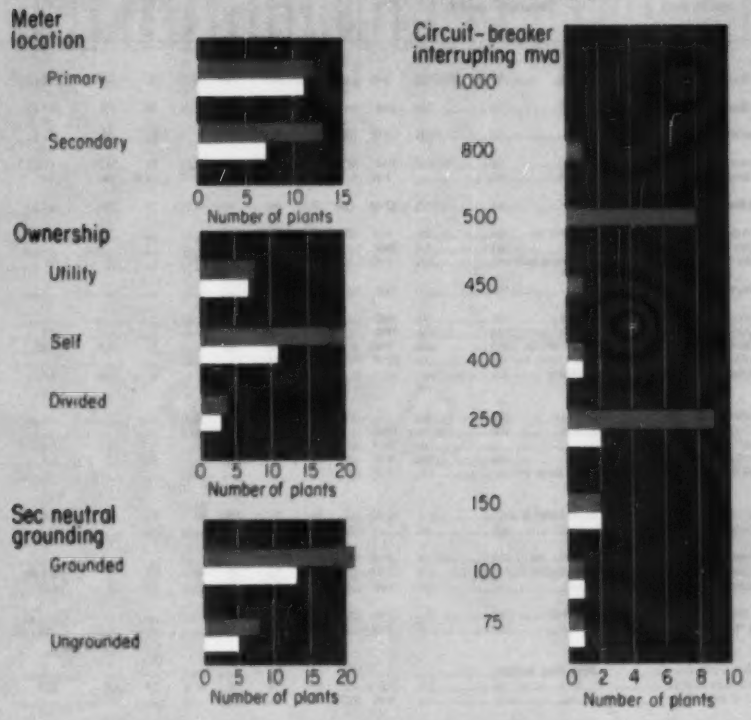
DRY TRANSFORMERS are out in front in both larger and smaller plants, though askarel comes close in larger plants. "Other voltages" include several secondaries at 2400, some 4160 volts



PLUG-IN BUSWAY is gaining wider acceptance. Most plants use more than one method

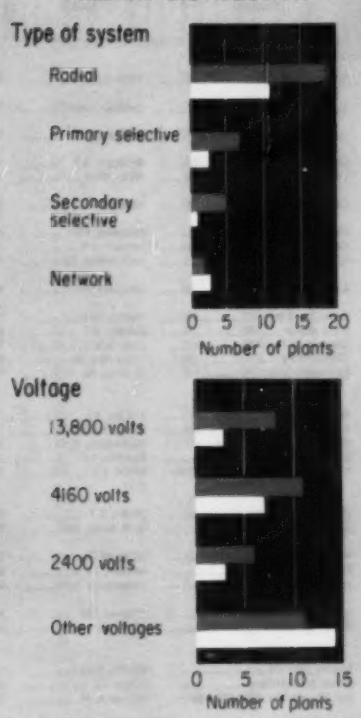
typical industrial plants, institutions

PRIMARY SUBSTATION



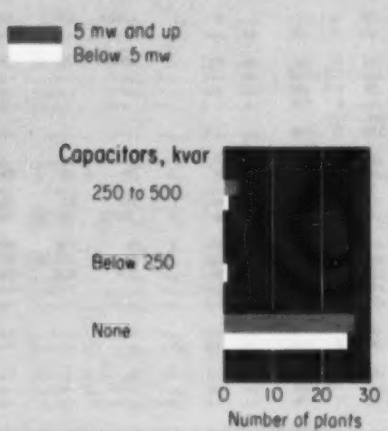
METER LOCATION is just about evenly divided between primary and secondary in larger plants. Self ownership of primary substations has taken a clear lead in plants over five megawatts

PRIMARY DISTRIBUTION



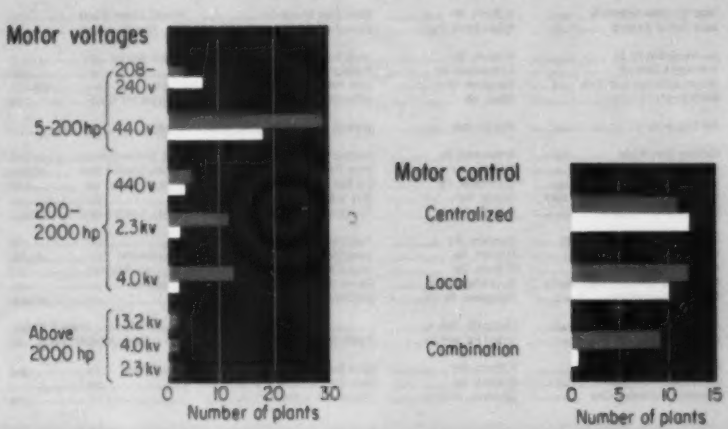
VOLTAGES listed as "other" include those around 11 and 12.5 kv and around 460 volts

POWER-FACTOR CORRECTION



CAPACITORS are not widely adopted, but one plant provides for adding them later

UTILIZATION



MOTOR VOLTAGE to 200 hp is predominantly 440 volts. Two industrial plants reported motors above 200 hp on 208 volts. Local motor control shows some increase over last year's survey

Design features of 60 typical electrical

Each listing covers 3 pages. Project number helps you track a specific installation after you turn facing page

Project Number	Company	Location	Electric Utility	Consulting Engineers	Date of initial operation	Plant area, acres	Total plant capacity, mw	EXISTING PLANT: TOTAL OLD LOAD: Max mw	TOTAL OLD LOAD: Avg pf	Self generated, mw	Utility supplied, mw	VOLTAGES: Utility supply, kv	VOLTAGES: Distribution, kv	VOLTAGES: Utilization, v
PLANTS 5 MW OR MORE														
1	Jones & Laughlin Steel Corp	Pittsburgh, Pa	Duquesne Light Co		3-60	.....	123.6	90	1.0	70	20	13.8	4164.16[8]	440[8]
2	Youngstown Sheet & Tube Co	Campbell, Ohio	Ohio Edison Co		1961	241	98	80	.95	42	38	138	6.9,2.3	6900
3	Jones & Laughlin Steel Corp	Cleveland, Ohio	Cleveland Illuminating Co		3-61	334	86	80	.95	5	75	132	44, 22 22,11,	11,000
4	Eastman Kodak Co	Rochester, N Y	Rochester G & E Corp		1960	993	67.1	58.1	.85	32.1[11]	26	34.11	4.16 13.8,2.3	2300,480
5	General Tire & Rubber Co	Akron, Ohio	Ohio Edison Co		3-60	.....	52[1]	51[12]	.9	.55	50.45	Var	Var	2300
6	Shell Oil Co	Wood River, Ill	Union Elect Co		12-60	1500	45.2	43	.90	20	23	34.5	6.9,2.3	440
7	Western Elect Co, Inc	Columbus, Ohio	Columbus & S Ohio E Co	C T Main, Inc	6-59	254	40[1]	No	.....	.....	.....	.....	.....	.....
8	Harrison Radiator Div, G M C	Lockport, N Y	N Y State E & G Co		1960	.....	40[1]	No	.....	.....	.....	.....	.....	.....
9	Pratt & Whitney Aircraft Corp	East Hartford, Conn	Hartford Electric Light Co	McConathy Hoffman	1-60	.....	37.5[1]	6	.9	28[3]	6	22	11	2300
10	A C Spark Plug Div, G M C	Oak Creek, Wis	Wisconsin Elect Power Co		1960	.....	30[1]	No	.....	.....	.....	.....	.....	.....
11	Euclid Div, G M C	Hudson, Ohio	Ohio Edison Co		1960	.....	30[1]	No	.....	.....	.....	.....	.....	.....
12	R C A Mfg Co	Camden, N J	Public Service E & G Co		1959	.....	28.1[1]	11.6	.85	14.5	.....	.....	2.3	440/220
13	Standard Oil Co (Ohio)	Lima, Ohio	Ohio Power Co	Badger Mfg Co	2-60	.....	25.5	21	.98	No	21	34.5	4.16	4000
14	Chrysler Corp	Valley Park, Mo	Union Electric Co	Albert Kahn, Inc	12-59	37	20[1]	No	.....	.....	.....	.....	.....	.....
15	Washington University	St. Louis, Mo	Union Elect Co	J D Falvey	.....	5	16.2	5	.80	1	2	4.16	2.4	208/120
16	Fort Dix, U S Army	Fort Dix, N J	Public Service E & G Co		.....	3600	15.75	No	.....	.....	.....	.....	.....	.....
17	General Tire & Rubber Co	Akron, Ohio	[13]		1960	.....	12.5	No	.....	.....	.....	.....	.....	.....
18	Standard Lime & Cement Co	Martinsburg, W Va	Potomac Light & Power Co		10-59	60	11.66	11.5	.985	No	11.5	34.5	4.16,2.4	440
19	Shell Oil Co	Martinez, Cal	Pacific G & E Co		9-59	700	11.2[4]	10.7	.90	No	10.7	12	2.3	2300,440
20	New Process Gear Div, Chrysler Corp	DeWitt, N Y	Niagara Mohawk Power Co	Albert Kahn, Inc	9-60	10	10[1]	No	.....	.....	.....	.....	.....	.....
21	Hackensack Water Co	Oradell, N J	Public Service E & G Co	Black, Seifert & Inst	6-60	.....	10	5	1.0	No	5	26	4.16	4000
22	Texas Instruments Inc	North Dallas, Tex	Dallas Power & Light Co		.....	300	10	No	.....	.....	.....	.....	.....	.....
23	Western Elect Co	Oklahoma City, Okla	Oklahoma G & E Co	C T Main, Inc	6-60	218	10	No	.....	.....	.....	.....	.....	.....
24	Edgewater Steel Co	Oakmont, Pa	Duquesne Light Co	Utility Survey Corp	8-59	52	8.4	4.6	.95	No	4.6	2.3	2.3, 46	440
25	Eli Lilly & Co	Indianapolis, Ind	Indianapolis P & L Co		6-60	34	7.9	7.05	.85	2.5	4.55	33	4.16	440
26	B F Goodrich Co	Ft Wayne, Ind	Ind & Mich Elect Co	Austin Co	7-61	287	7.5	No	.....	.....	.....	.....	.....	.....
27	Miami Int'l Airport Terminal	Miami, Fla	Florida Power & Light Co	[14]	2-60	.....	6.67	No	.....	.....	.....	.....	.....	.....
28	Sharon Silica Co	Oak Hill, Ohio	Columbus & Ohio Elect Co	Ming, Ming, Dehart	.....	1460	6.6[1]	No	.....	.....	.....	.....	.....	.....
29	Climax Molybdite Co	Climax, Col	Public Service Co of Col		1960	.....	5.8[1]	2.8	.94	No	2.8	115	13.8	2300,480
30	Gen Chemical Div, Allied Chem Corp	Metropolis, Ill	Central Ill Pub Serv Co		4-60	100	5.5	No	.....	.....	.....	.....	.....	.....
31	Lion Oil Co Div, Monsanto Chem Co	El Dorado, Ark	Arkansas Power & Light Co	Procon, Inc; Badger	.....	.....	5.4	3.4	.85	No	3.4	13.8	2.3	440,2300
32	Corning Glass Works	Martinsburg, W Va	Potomac Light & Power Co	Day & Zimmerman	7-60	6	5[1]	No	.....	.....	.....	.....	.....	.....
33	Norden Div, United Aircraft Corp	Norwalk, Conn	Conn L & P Co	Wigton Abbot	1-61	9	5	No	.....	.....	.....	.....	.....	.....
FOLLOWING PLANTS ARE LESS THAN 5 MW														
34	Int'l Business Machines Corp	San Jose, Cal	Pacific G & E Co	Lyle Patton, Kellar & Garrison	6-59	192	4.75	4.5	.91	No	4.5	11.0	11.0	208/120
35	Jones & Laughlin Steel Corp	Coleraine, Minn	Minn Power & Light Co		.....	.....	4.5[1]	No	.....	.....	.....	.....	.....	.....
36	Westinghouse Elect Corp	Youngwood, Pa	West Penn Power Co		10-60	3.75	4	1.8	.80	No	1.8	25	4.16	208/120
37	National Gypsum Co	Lorain, Ohio	Ohio Edison Co		3-60	.....	3.1[1]	No	.....	.....	.....	.....	.....	.....
38	General Electric Co	Richmond Hts, Ohio	Cleveland Elect Illum Co		1-60	4	2.7	No	.....	.....	.....	.....	.....	.....
39	Texas Christian University	Ft Worth, Tex	Texas Elect Service Co	Yandell, Cowan & Love	6-59	250	2.6	2	.....	No	2	4.16/2.4	4.16/2.4	440
40	Radio Corp of America	Wilkes Barre, Pa	Penn P & L Co	Lacy, Atherton & Davis	7-60	110	2.5	No	.....	.....	.....	.....	.....	.....
41	Southwest Bell Tel Co	Ft Worth, Tex	Texas Elect Service Co	Wyatt C Hedrick	9-60	4.8	2.2	.7	.....	No	.7	.208/.120	.208/.120	208/120
42	Baltimore & Ohio RR	Cumberland, Md	Potomac Edison Co		12-60	.....	2.15	.65	.....	.....	.....	.....	.....	.....
43	Universal Cyclops Steel Corp	Coshocton, Ohio	Ohio Power Co		3-60	15	2.12	No	.....	.....	.....	.....	.....	.....
44	White Rogers Co	Affton, Mo	Union Electric Co	Sacks Electric Corp	10-60	.....	2	No	.....	.....	.....	.....	.....	.....
45	Big Rock Gravel Co	Pike Co, Ohio	Buckeye Rural Coop		1960	740	2[1]	No	.....	.....	.....	.....	.....	.....
46	Corning Glass Works	Greencastle, Pa	Southern Penn Electric Co	Day & Zimmerman	10-60	14	1.5[1]	No	.....	.....	.....	.....	.....	.....
47	St Joseph's Hospital	Ft Worth, Tex	Texas Elect Service Co	Yandell, Cowan & Love	6-59	50	1.5	.4	.....	No	.4	.24	.24	240
48	Union Oil Co	Los Angeles, Cal	L A Dept of Water & Power	Ehrhart & Assoc, Inc	6-59	2	1.5[1]	No	.....	.....	.....	.....	.....	.....
49	Samuel-Subsky Div, Allied Chem Corp	Orange, Tex	Gulf States Utility Co		9-60	.....	1.3	1	.85	No	1	13.2	2.3	440
50	Ft Worth Club	Ft Worth, Tex	Texas Elect Service Co	Yandell, Cowan & Love	.....	.....	1.3	.6	.85	No	.6	.208/.120	.208/.120	208/120
51	Barrett Div, Allied Chemical Corp	Edgewater, N J	Public Service E & G Co		2-60	5	1.3[1]	.8	.8	No	.8	26	4.16	440
52	U S Post Office	Ft Worth, Tex	Texas Elect Service Co	Leonard Kamb	5-59	.....	1.07	.285	.85	.....	.285	.208/.120	.208/.120	208/120
53	Ft Worth General Depot	Ft Worth, Tex	Texas Elect Service Co	Army Corp of Engrs	1960	150	1.094	....[4]	.....	No	....[4]	12.47	12.47	240/120
54	Minneapolis-Honeywell Regulator Co	Riviera Beach, Fla	Florida Power & Light Co	Ellerbe & Co	7-60	15	1	No	.....	.....	.....	.....	.....	.....
55	Westinghouse Elect Corp	Youngwood, Pa	West Penn Power Co		10-60	1.2	.8	No	.....	.....	.....	.....	.....	.....
56	Johns Manville Products Corp	Chillicothe, Ohio		Graham, Anderson, Probst & White	5-60	50	.8	No	.....	.....	.....	.....	.....	.....
57	Eli Lilly & Co	Greenfield, Ind	Public Service Co of Ind, Inc	Vern G Alden; Allied Architects	9-59	600	.8	.....	.....	.....	.....	.....	.....	.....
58	All Saints Hosp of Ft Worth	Ft Worth, Tex	Texas Elect Service Co	Leonard Kamb	6-59	15	.8	No	.....	.....	.....	.....	.....	.....
59	Clarks Department Store	Ft Worth, Tex	Texas Electric Service Co		.....	.....	.750	No	.....	.....	.....	.....	.....	.....
60	Industrial Nucleonics Corp	Columbus, Ohio	Columbus & S Ohio Elect Co		7-59	26	.4	No	.....	.....	.....	.....	.....	.....

1 - Initial demand not available. Estimated mw based on equipment capability
2 - Delta with one grounded phase
3 - Emergency or test purposes only
4 - Complete load data not available
5 - Switchgear station
6 - Future
7 - Includes old and new installation
8 - Also 250 v dc
9 - Resistance grounded main sub; secondary subs grounded only on 4160 volts
10 - 50,000 amp
11 - Generating cap 67 mw; no new generators
12 - All domestic plants
13 - Ohio Edison Co plus W Ky Rural Elect Coop
14 - Steward & Skinner; Maurice Connell; Baker Engineering Co
15 - 100,000 amp
16 - 13,200 amp
17 - 1-100 hp, 440 v; 125-500 hp, 2300 v
18 - 13.8 kv impedance grounded; 2.3 kv not grounded
19 - Fuse rating
20 - 35,000 amp
21 - 20,000 amp
22 - New plant supplied from existing sub
23 - 75,000 amp

distribution systems, new and modernized

GENERATION (NEW LOAD)					UTILITY SUPPLIED NEW LOAD			PLANT VOLTAGES						PRIMARY SUBSTATION							
	NEW UNITS									MOTOR VOLTAGE, V				TRANSFORMERS							
Total generating capacity, mw	Voltage, kv	No.	Pf.	Manufacturer	Min mw	Avg pf	kv	Distribution, kv	Utilization, v	5-200 hp	201-2000 hp	2001 hp-upward	265-v lights	Number of subs	Number each sub	Manufacturer	Impedance, %	Secondary neutral grounded	Circuit breaker 3-ph interrupting mva	Available s-c, mva	Point Number
No	.....	.....	.....	.....	33.6	.98	13.8	13.8	4000, 440[8]	440	4000	13,200	No	1	2	P	8	Yes[9]	500	316	1
.....	.....	.....	.....	.....	18	.95	138	13.8	13.8	440	2301	13,800	No	3	2,1,1	ACM	12	Yes	500	....[10]	2
No	.....	.....	.....	.....	6	.9	11	11	4000	440	4000	.....	No	1	1	GE	5.5	Yes	500	450	3
.....	.....	.....	.....	.....	9	.85	11	13.8	2300, 440	440	2301	2300	Yes	1	1	GE	6.67	Yes	500	297	4
No	.....	.....	.....	.....	1[1]	.....	.....	4.16	.....	440	4000	.....	Yes	1	1	ITE	5.5	Yes	.....	.....	5
No	.....	.....	.....	.....	2.2	.90	34.5	2.3	2300	440	2300	.....	No	1	1	WE	6.1	No	100	65	6
No	.....	.....	.....	.....	40[1]	.....	13.8	.460	440	440	4000	.....	Yes	1	2	.....	.....	Yes	.....	....[10]	7
No	.....	.....	.....	.....	40[1]	.....	.....	11.5	460	460	2300	.....	Yes	2	1	.....	.....	No	250	150	8
.....	.....	.....	.....	.....	11[1]	.9	22	11	2300	440	4000, 2300	.....	No	1[7]	2	WE	4	Yes	500	.....	9
No	.....	.....	.....	.....	30[1]	.....	.....	13.2	.....	440	460	.....	No	1	2	.....	.....	No	500	.....	10
No	.....	.....	.....	.....	30[1]	.....	.....	13.2	440	440	440	.....	No	1	1	.....	.....	Yes	500	.....	11
12	.....	.....	.....	.....	4.5	.80	26.4	2.3	440/220	440/220	2300	.....	No	1	2	GE	6.5,98	No	450	150	12
No	.....	.....	.....	.....	4.5	.90	34.5	4.16	4000	440	4000	4000	No	1[7]	2	GE	8	Yes	250	230	13
No	.....	.....	.....	.....	20[1]	.....	.....	12.47	480	440	.....	.....	No	1	2	.....	.....	No	250	100	14
3.2	.....	.....	.....	.....	10	.80	34.5/4.16	4.16	2300, 208/120	208	2300	.....	No	1	2	ACM, No	6	Yes	150	50	15
No	.....	.....	.....	.....	15.75	.....	.....	4.16	220	220	2300/4000	.....	No	4	....[26]	Var	.....	Yes	.....	.....	16
No	.....	.....	.....	.....	5,7.5[13]	.....	12.5,69	4.16,2.3	460/265	440	4000,2300	.....	Yes	2	3,1	ACM, GE	7,8.5	Yes	150	80	17
No	.....	.....	.....	.....	.16	.90	34.5	4.16	440	.....	.....	.....	No	1	1	GE	6.17	Yes	250	100	18
No	.....	.....	.....	.....	.5[1]	.....	.....	2.3	440	440	.....	.....	No	...	.....	.....	.....	.....	.....	.....	19
No	.....	.....	.....	.....	10[1]	.....	.....	13.8	440	440	.....	.....	No	1	3	WE	7.75-10.75	No	250	.....	20
No	.....	.....	.....	.....	5	1	26	4.16	4000	.....	4000	4000	No	1	2	.....	6.75	No	.....	.....	21
No	.....	.....	.....	.....	10	.90	13.2	13.2	440	440	4000	.....	Yes	1	2	ACM	7	Yes	400	286	22
																					23
No	.....	.....	.....	.....	10	.85	12.5	12.5	460/265	440	440	.....	Yes	...	1	2	7.5	Yes	500	252	23
No	.....	.....	.....	.....	4.75	.....	2.3	2.3, 46	440	2300, 440	2300	.....	No	1	4	.....	.....	.....	.....	.....	24
.....	.....	.....	.....	.....	.85	.85	33	4.16	440	440	4160	.....	Yes	1	2	WE	6.3	Yes	250	174	25
No	.....	.....	.....	.....	7.5	.95	4.16	4.16	4000	440	4000	.....	Yes	1	1	GE	8	Yes	250	138	26
6[3]	480/.277	.3 .15 .22	.8	CE Ca EM	6	.85	.480	.460/.265	460/265	440	440	.....	Yes	3	5,3,2	GE WE ACC	5	Yes	....[15]	.....	27
No	.....	.....	.....	.....	6.6[1]	.....	.....	12.47	.....	440	.....	.....	No	5	4,6	WE, ACM, LM	.....	.....	100	.....	28
No	.....	.....	.....	.....	3[1]	.....	115	2.4, 48	440	440	2400	.....	No	2	2	GE, WE	5.5	Yes	250	.....	29
No	.....	.....	.....	.....	5.5	.90	4.16	4.16	440	440	440	.....	No	1	1	GE	.....	Yes	250	....[16]	30
No	.....	.....	.....	.....	2	.85	13.8	13.8, 2.4	440, 2300	440[17]	2300[17]	.....	No	3[7]	3,3,1	P, W, GE	4.6,5.7, 5.8	....[18]	.....	.....	31
No	.....	.....	.....	.....	5[1]	.....	4.16	4.16	460/265	440	2300, 4000	.....	Yes	1	1	WE	.....	Yes	.....	150	32
No	.....	.....	.....	.....	5	.....	28	.460	440	440	.....	.....	No	1	1	GE	5	No	75	70	33
No	.....	.....	.....	.....	.24	.....	11.8	11.8	208/120	.....	.....	.....	Yes	...	.....	.....	.....	.....	.....	.....	34
No	.....	.....	.....	.....	4.5[1]	.95	22	4.16	440	440	.....	.....	.....	2	1	W, N	5.6,5.75	Yes	.....	.....	35
No	.....	.....	.....	.....	2.2	.80	25	4.16	208/120	208	.....	.....	No	1	2	WE	6.5	Yes	150	100	36
No	.....	.....	.....	.....	3.1[1]	.....	.....	4.16	440	440	4000	.....	No	1	1	GE	7.44	Yes	.....	.....	37
No	.....	.....	.....	.....	2.7	.90	33	.460/.265	265	440	.....	.....	Yes	1	3	GE	5.4	Yes	.....	.....	38
No	.....	.....	.....	.....	.6	.....	4.16/2.4	4.16/2.4	440	440	440	.....	No	1	1	P	.....	Yes	.....	.....	39
No	.....	.....	.....	.....	2.5	.90	12.6	.460/.230	.....	.....	.....	.....	No	1	4	ITE	.....	No	.....	.....	40
....[3]	.....	.....	.....	.....	1.5	.85	.480	.48	208/120	440	440	.....	No	...	.....	.....	.....	.....	.....	.....	41
No	.....	.....	.....	.....	1.5	.86	12.47/7.2	12.47/7.2	440	440	.....	.....	Yes	1	.....	.....	.....	.....	.....	.....	42
No	.....	.....	.....	.....	2.12	1.0	13.8	13.8	4160, 460	440	4000	.....	No	1	1	.....	.....	Yes	250	69	43
No	.....	.....	.....	.....	2	.8	12.47	.240 .208Y/.120	240	220	.....	.....	No	1	.....	.....	.....	.....	400[19]	.....	44
No	.....	.....	.....	.....	2[1]	.....	12.47	12.47	.....	440	2300	.....	No	2	6	GE	.....	Yes	.....	.....	45
No	.....	.....	.....	.....	1.5[1]	.....	4.16	4.16	460/265	440	.....	.....	Yes	1	3	.....	.....	Yes	.....	.....	46
.25[3]	.48	.25	.....	SI	1.1	.....	4.16/2.4	4.16/2.4	440/220	220	440	.....	No	1	3	.....	.....	No	.....	.....	47
No	.....	.....	.....	.....	1.5[1]	.....	.....	2.4	2400	440	2300	.....	No	1	4	.....	.....	No	.....	.....	48
No	.....	.....	.....	.....	.3	.80	13.2	2.3	440	440	.....	.....	No	1	1	WE	4.8	No	....[20]	....[21]	49
No	.....	.....	.....	.....	.7	.85	.208/.120	.208Y/.120	208/120	208	208	.....	No	No	.....	.....	.....	.....	.....	.....	50
.....	.....	.....	.....	.....	5[1]	.....	26	4.16	440	440	.....	.....	No	...	.....	.....	.....	.....	.....	.....	51
No	.....	.....	.....	.....	.705	.85	.208Y/.120	.208Y/.120	208/120	208	208	.....	No	No	.....	.....	.....	.....	.....	.....	52
No	.....	.....	.....	.....	1.05	.....	12.47	12.47	240	240	.....	.....	No	...[5]	.....	.....	.....	.....	....[5]	.....	53
No	.....	.....	.....	.....	1	.....	13.8	13.8	440	440	440	.....	Yes	1	1	.....	.....	Yes	.....	.....	54
No	.....	.....	.....	.....	.8	.80	25	4160	208/120	208	.....	.....	No	1[22]	2	WE	6.5	Yes	150	100	55
No	.....	.....	.....	.....	.8	.....	.480	460	440	440	.....	.....	No	1	1	P	3.8	No	....[23]	35	56
1[3]	.....	.1[3]	.....	USM	.8	.85	13.2	13.2	440	440	.....	.....	No	4	1	WE, ITE	.....	Yes	250	.....	57
.15[3]	.480	.15	.8	SI	.8	.....	.480	.480	440	440	.....	.....	No	1	3	.....	.....	....[2]	.....	.....	58
No	.....	.....	.....	.....	.750	.....	.460/.265	.460/.265	.....	440	.....	.....	Yes	1	3	.....	.....	Yes	.....	.....	59
No	.....	.....	.....	.....	.4	.93	13.2	460/265	440	440	.....	.....	Yes	1	1	GE	.....	Yes	.....	....[10]	60

AB - Allen-Bradley Co
ACM - Allis-Chalmers Mfg Co
ASW - American Steel & Wire Div, US Steel Corp
AWC - Anaconda Wire & Cable Co
BE - Building Electric Products Co
C - Clark Controller Co
Ca - Caterpillar Tractor Co
CE - Columbia Electric Mfg Co
CH - Cutler-Hammer, Inc
Co - Continental Electric Co, Inc
CWC - Crescent Insulated Wire & Cable Co
Do - Delco Products Div, General Motors Corp
EC - The Ellett Co
EM - Electric Machinery Mfg Co
ES - The Electric Service Co, Inc
EW - Essex Wire Corp
FP - Federal Pacific Electric Co
GC - General Cable Co
GE - General Electric Co
GM - General Motors Corp
HD - Heil-Duty Electric Co
He - Hendrix Wire & Cable Corp
IE - Ideal Electric & Mfg Co
ITE - I-T-E Circuit Breaker Co
J - Jefferson Electric Co
K - Kaiser Aluminum & Chemical Sales, Inc
Ke - Kerite Co
LA - The Louis Allis Co
LM - Line Material Co
ME - Marathon Electric Co
Mo - Moloney Electric Co
N - Niagara Transformer Co, Inc
Ok - The Okonite Co
P - Pennsylvania Transformer Co
Pa - Paranite Co
PD - Phelps Dodge Copper Products Corp
PE - Penn Electric Co
RE - Reliance Electric & Engineering Co
Rb - Rockbestos Products Corp
RS - J A Roebling's Sons Corp
SC - S & C Electric Co
SD - Square D Co
SE - Sprague Electric Co
So - Sorgel Electric Co
St - Stewart & Stevenson Co
SW - Simplex Wire & Cable Co
Up - R E Uptegraff Mfg Co, Inc
USM - United States Motors Corp
W - Wagner Electric Corp
WE - Westinghouse Electric Corp

Electrical design features continued

Compiled by: Norman Peach, Associate Editor

Project number	PRIMARY SUBSTATION (Cont.) Switchgear Manufacturer	Ultimate sub capacity, mva	Ownership	Meter location	PRIMARY DISTRIBUTION (ABOVE 600 v) Circuitry	Overhead or underground	Distribution means	Cable manufacturer	SECONDARY SUBSTATIONS Number	Unit sub manufacturer	Transformer type	Manufacturer	Secondary neutral grounded	SECONDARY DISTRIBUTION Means	Busway manufacturer	Cable manufacturer	UTILIZATION TOTAL LOAD DIVISION Lighting, %	Motors, %	Welding, % (Supply capacity)	Heat and process, %	Dc, %	Total motor hp	Motor manufacturer(s)	MOTOR CONTROL Centralized or local	Control manufacturer(s)	Capacitors, kvar	Lighting type
1	GE	62	S	Both	SS	Ov	AC	.....	14	GE,WE, W,P,ITE	All	.....	9	PB,CC	WE,GE	SW,AWC,	20	65	12	3	40	176,480	WE,GE, W,EC	Loc	WE,GE	.....	F,I,M
2	GE	24	S	Pri	SS	Ov	IA	.....	10	ACC,GE	Dry	ACC,GE	Yes	CC	.....	GE,CC, AWC	10	65	10	...	15	40,000	GE,WE, ACM	Cen	GE,WE, ACM	No	I,M
3	GE	3.75	S	Both	Ra	.....	.....	.....	2	GE	Ask	GE	No	IA,CC, TC	.....	GE	10	90	...	...	...	7,200	GE,EM	Cen	GE	.....	F,M
4	GE	20	S	Sec	SS	Un	CC	Var	3	Var	Dry,Ask	Var	No	CC25	BE	Var	30	65	3	1	1	.....	Var	Loc	Var	300	F,I,M
5	ITE	1.25	S	.....	Ra	Ov	IA	GE	...	.....	.....	.....	.....	TC	.....	GC	5	90	...	...	...	1,500	RE	Cen	S,D,C	.....	F
6	WE	6.25	S	Sec	Ra	Un	CC	.....	1	.....	Oil	Mo	No	CC	.....	.....	3.5	95.5	0.5	0.5	...	3,551	GE,WE, ACM,CO	Cen	WE,GE	.....	F,I,M
7	ITE	40	U	.....	Ra	Ov	CC	.....	20	ITE	Dry	P	Yes	PB,CC	BE,GE	.....	40	50	10	...	...	.....	GE,WE	Loc	AB,WE	.....	F,M
8	.....	20	S	Sec	PS	Un	CC	.....	3	.....	Dry	.....	Yes	PB,CC	.....	.....	...	...	...	...	...	.....	De	Both	.....	.....	F
9	WE	56.25	S	Pri	Ra	Un	CC	SW,AWC	3	WE,GE	Dry,Ask	.....	No	CC	.....	.....	1	99	...	...	...	6,000	Var	Loc	.....	.....	F,M
10	.....	30	S	Pri	PS	Un	CC	.....	3	.....	Ask	.....	No	PB,CC	.....	.....	...	...	...	...	...	.....	De	Both	.....	.....	F
11	.....	30	U	Sec	PS	Un	.....	.....	5	.....	Dry	.....	No	PB,CC	.....	.....	...	...	...	...	...	.....	De	Both	.....	.....	F
12	GE	15	S	.....	Ra	Un	CC	Var	5	GE	Oil	.....	No	PB,CC	.....	Var	45	6	46	2	1	.....	Var	Loc	Var	.....	F,I
13	GE	28.8	S	Pri	Ra	Un	IA	GE	1	GE	Oil	GE	No	CC	.....	GE	3	97	...	...	...	5,955	GE,WE	Cen	GE	.....	I
14	WE	20	D	Sec	Ra,SS	Ov	IA	Ok	2,	WE	Ask	WE	.....	PB,IA	BE	Ok	17	11	50	22	0	.....	.....	Cen	EM,AB	400	F
15	ITE	20	D	Sec	Ra,No	Un	CC	GE,Ok	13	Var	Dry	Var	Yes	CC	.....	Var	60	30	10	...	1	1,300	Var	Loc	.....	.....	F,I,M
16	Var	26	S	Pri	Ra	Ov	AC	.....	950	Var	Oil	.....	.....	.....	.....	.....	80	20	...	...	...	4,000	Var	Loc	.....	.....	F,I
17	ITE,GE	5,7.5,27	U,S13	Sec28	Ra27	Ov	IA	GE,GC,AWC	6	P,GE	Oil,dry	.....	Yes	CC,TC	.....	.....	10	90	...	...	...	10,000	GE,WE	Cen	GE,WE,AB	.....	.....
18	GE	9.38	S	Pri	Ra	Ov	IA	PD	3	GE	Ask	GE	Yes	IA	.....	PD	2	95	1	1	1	5,000	GE	Loc	GE	.....	I
19	.....	.....	.....	.....	Ra	Ov	CC	SW,AWC	1	WE	Oil	.....	No	CC	.....	SW,AWC	10	82.5	7.5	...	...	300	LA,ACM	Cen	WE	.....	I
20	ITE	10	D	Sec	Ra,SS	Ov	IA	AWC	5	ITE	Ask	.....	No	PB,IA	WE	PD	15	11	74	0	0	.....	.....	Both	.....	.....	F
21	ACM	12	S	Pri	No	Ov	CC	PD	No	.....	.....	.....	.....	CC	.....	PD	2	95	3	...	...	6,000	IE	Loc	IE	.....	F,I
22	ITE	40	U	Both	Ra	Un	CC	AWC	28	GE,WE, ACM	Dry	GE,WE, ACM	Yes	PB,IA, CC,TC	GE,SD, WE	AWC, GE,SW	26	40	34	...	...	4,200	GE,WE, ACM	Both	GE,WE, ACM	.....	F,I,M
23	ITE	15	U	Sec	PS	.....	CC	K	18	ITE	Dry	ITE	Yes	PB,IA,CC	BE	Var	25	45	30	...	...	.....	Var	Loc	Var	.....	F,I,M
24	GE,WE	7	.....	Sec	PS	Ov	IA,CC	GE,GC	4	GE,WE	.....	.....	.....	IA,CC	.....	.....	5	90	5	...	...	4,500	.....	Both	.....	400	F,I,M
25	WE	19.4	S	Pri	PS	Un	CC	Ok,Ka	2	WE	Ask	WE	Yes	PB,CC	.....	.....	40	50	10	...	...	.....	GE,LA,ACM	Cen	WE	.....	F,I,M
26	GE	15	U	Sec	Ra	Ov	IA	GE	4	WE	Ask	WE	Yes	IA,TC	.....	GE,EW	20	65	5	...	20	21,000	ACM,WE	Cen	GE,CH	.....	F,I
27	WE,GE	5,3,1.5	U	Sec	Ra,PS	Un	CC	GC	20	GE,WE	Dry	GE,WE	Yes	CC	.....	GC	60	40	...	...	...	4,300	Var	Loc	.....	.....	F,I
28	.....	.....	S	Pri	.....	Ov	CC	.....	8	.....	Oil,dry	.....	Yes	CC,TC	.....	.....	...	...	...	...	...	.....	.....	Cen	.....	.....	F,I
29	GE,WE	1.5	S	Sec	No	Ov	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	1	98	1	...	...	.....	.....	Loc	GE,WE	.....	I,M
30	GE	15	U	Pri	Ra	Ov	AC	PD	6	GE	Oil	GE	No	IA,CC	.....	PD	5	40	5	...	50	4,000	WE	Both	GE	.....	F,I,M
31	.....	.....	S	Pri	29	Ov	30	.....	157	.....	Oil	GE,WE	31	CC30	.....	Var	4	94	...	2	...	.....	LA,GE, ACM,WE	Both	WE,GE	225	F,I
32	WE	5	D	Sec	Ra	Ov	IA	GE	4	WE	Ask	WE	Yes	PB,IA,CC	WE,GE	GE	30	55	15	0	0	.....	.....	Both	WE,AB	No	I,F,M
33	GE	6	S	Pri	SS	Un	CC	.....	2	GE	Dry	GE	Yes	PB,CC	.....	.....	40	40	15	4	1	1,500	Var	Both	Var	.....	F,M
34	.....	.....	.....	.....	PS	.....	.....	.....	1	ITE	Dry	.....	Yes	CC	.....	Var	48	28	...	...	...	80	GE	Cen	WE	.....	F
35	GE,WE	.....	S	Pri	.....	Ov	CC	SW	3	.....	Oil,dry	GE,W	No	CC	.....	SW	...	...	...	...	...	.....	GE,WE,W	Cen	CH	300	F,I,M
36	WE	6	S	Sec	No	Ov	IA	.....	4	WE	Dry	WE	Yes	PB,CC	WE	GC	20	10	70	...	...	.....	.....	.....	.....	.....	F,M
37	GE	3.1	S	Pri	.....	Ov	AC	.....	2	GE	Ask	GE	Yes	CC	.....	.....	...	...	...	...	...	.....	GE	Cen	GE	6	F,I
38	GE	5	U	Pri	.....	Un	CC	GE	2	GE	Oil	GE	Yes	PB,IA, CC,TC	GE	GE	50	30	10	5	5	700	GE	Loc	GE	.....	F,I
39	SD	1	S	Pri	.....	Un	CC	.....	...	.....	.....	.....	.....	CC	.....	.....	...	100	...	...	...	.....	.....	.....	.....	.....	.....
40	.....	.....	S	Pri	SS	.....	CC	.....	...	.....	.....	.....	.....	PB	BE	.....	15	30	...	...	...	.....	.....	Loc	.....	.....	F
41	.....	.....	.....	.....	.....	.....	.....	.....	12	.....	Dry	.....	Yes	PB,CC	.....	.....	40	60	...	...	...	1,400	.....	Cen	.....	.....	F
42	.....	2.5	D	.....	Ra	Ov	33	Var	5	.....	Oil,dry	.....	No	CC	.....	Var	25	25	50	...	...	475	WE	Both	SD,WE	.....	F,I,M
43	GE	7.5	U	Sec	PS	Un	CC	Ok	3	GE,WE	Ask	GE,WE	No	CC	.....	Var	25	75	...	...	...	.....	ACM,EC,WE	Cen	WE	.....	F,M
44	SC	12	S	Pri	Ra	Ov	IA	GE	5	FP	Dry	HD	2	PB,CC	FP	.....	13.5	60	16.8	9.7	...	2,000	Var	Loc	Var	No	F
45	.....	1	U	Pri	Ra	Un	DB	.....	2	.....	Oil,dry	.....	.....	.....	.....	.....	...	...	...	...	...	.....	.....	.....	.....	.....	.....
46	SC	1.5	U	Sec	Ra	Ov	CC	PD	3	WE	Dry	WE	Yes	PB,CC	BE	PD	55	45	...	...	...	.....	WE	Loc	AB	No	F,A
47	ITE	3	S	Pri	Ra	Un	CC	.....	4	ITE	Dry	ITE	Yes	CC	.....	.....	40	60	...	...	...	1000	.....	.....	.....	.....	.....
48	GE	1.5	D	Sec	Ra	Un	CC	.....	No	.....	.....	.....	.....	CC	.....	.....	0.5	99.5	...	...	...	1,130	WE	Cen	SD	.....	F,I
49	WE	1	S	Pri	Ra	Ov	AC	.....	1	WE	Oil	WE	No	CC	.....	GE	17	83	...	...	...	450	Var	Cen	WE	.....	I,F
50	.....	.....	.....	.....	No	.....	.....	.....	No	.....	.....	.....	.....	CC	.....	.....	40	60	...	...	...	600	.....	Loc	.....	.....	F,I
51	.....	.....	.....	.....	Ra	Ov	IA	SW	1	P	Ask	P	Yes	CC,TC	.....	GC	5	90	...	5	...	1,100	EC	Cen	AB	.....	I
52	.....	.....	.....	.....	.....	.....	.....	.....	No	.....	.....	.....	.....	PB,CC	.....	.....	25	75	...	...	...	.....	.....	Cen	.....	.....	F,I
53	.....	.....	S	Pri	Ra	Ov	AC	.....	...32	.....	.....	.....	.....	CC	.....	.....	60	20	20	...	...	.....	Var	Loc	Var	.....	I
54	SD	1	S	Pri	Ra	Un	CC	GC	2	.....	Dry	GE	Yes	PB,CC	SD	.....	40	60	...	...	...	700	.....	Loc	.....	.....	F
55	WE	6	S	.....	No	Un	IA	.....	1	WE	Dry	WE	Yes	PB	.....	.....	20	10	70	...	...	.....	WE	Cen	WE	.....	F,M
56	WE	3	D	Sec	No	.....	.....	.....	No	.....	.....	.....	.....	CC	.....	Pa	10	78	2	...	10	2,200	GE	Cen	C	.....	F,I,M
57	WE, ITE	.75,.5, .11,.11	S	Pri	PS	Ov	AC	He	No	.....	.....	.....	.....	CC	.....	GC	56	44	...	...	...	.....	GE,WE, ACM,LA	Cen	WE	195	F
58	GE	1	U	Sec	Ra	Ov	AC	.....	1	GE	Dry	ES	Yes	CC	.....	.....	50	50	...	...	...	600	GE	Loc	GE	No	I
59	.....	.750	U	.....	Ra	Ov	AC	.....	.....	.....	.....	.....	.....	CC,TC	.....	.....	50	50	...	...	...	.....	.....	.....	.....	.....	.....
60	BE,ITE	.75	U	Sec	.....	.....	.....	.....	No	.....	.....	.....	.....	PB	BE	.....	...	...	...	...	...	.....	.....	Loc	.....	.....	F

For key to manufacturers see preceding page

2 - Delta with one grounded phase
6 - Future
7 - Includes old and new installation
9 - Resistance grounded main sub; secondary subs grounded only on 4160 volts

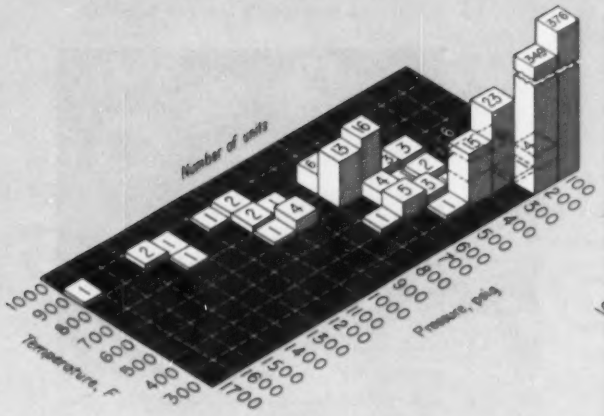
13 - Ohio Edison Co plus W Ky Rural Elect Coop
26 - 40,000, 28,000, 20,000 kva
25 - Also some PB, IA, TC
26 - 1 at 2 mw; 1 at 3.75 mw; 1 at 2.5 mw; 6 at 1 mw; 3 at 0.5 mw
27 - Future 55; double transformer capacity
28 - Compensated
29 - Looped radial

30 - Open wire
31 - One station only
32 - New load carried by existing subs
33 - Open pole lines. Plant is transportation yard
AC - Aerial Cable
Cen - Central
D - Divided ownership
DB - Direct Burial

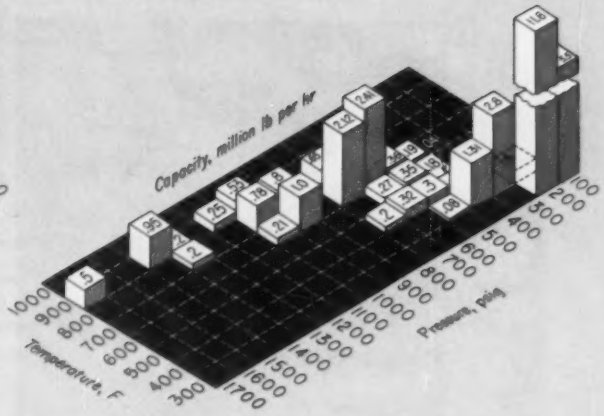
F - Fluorescent
I - Incandescent
IA - Interlocked armored cable
Loc - Local
M - Mercury-vapor
No - Network
Ov - Overhead
PB - Plug-in busway
Pri - Primary

PS - Primary selective
Ra - Radial
S - Self ownership
Sec - Secondary
SS - Secondary selective
TC - Trough & cable
U - Utility ownership
Un - Underground
Var - Various

TODAY'S STEAM CONDITIONS

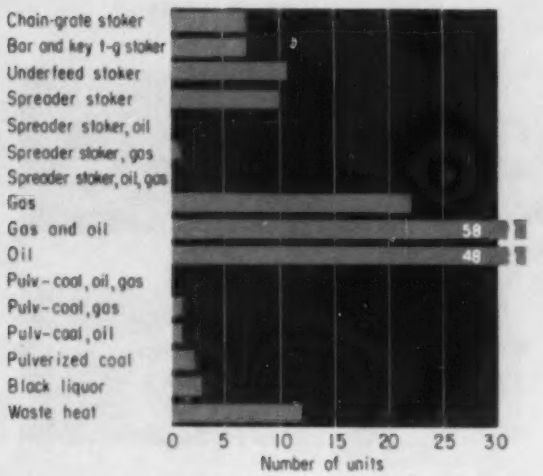


TOTAL BOILER SALES reported show increase over previous survey. Packaged and shop-assembled units represent some 88% of the total



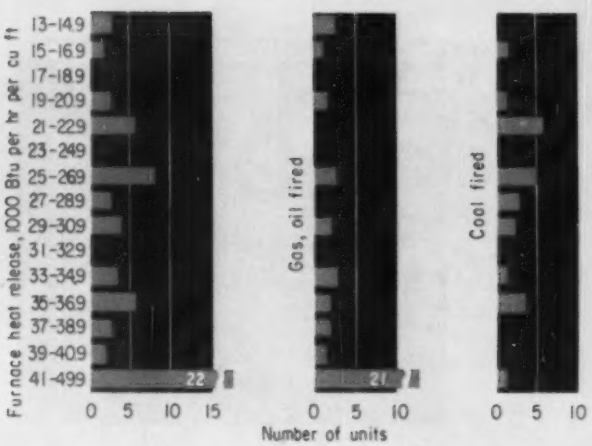
TOTAL CAPACITY is 9-M lb per hr more than listed last year. While more units were sold, majority fall in modest-capacity group

FIRING METHODS



OIL-AND-GAS combinations again head the list, but oil-fired units continue last year's growth and begin to challenge the leader

HEAT RELEASE



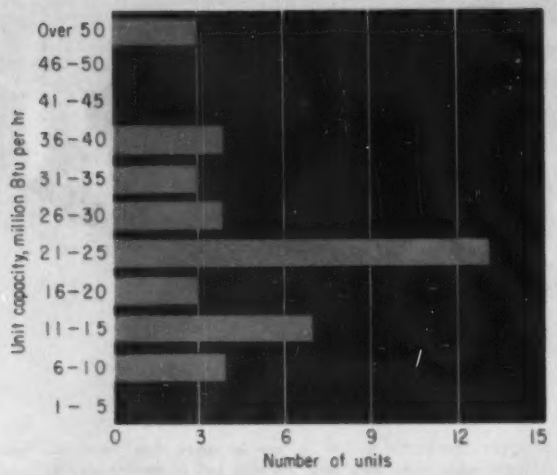
HEAT-RELEASE RANGES for fuels tabulated show no significant changes from previous year. Coal loses slightly in the middle range

INDUSTRIAL PLANT: capacity curve rises

Industrial capacity begins to climb, reversing last year's declining trend. Reported sales of steam-generating units tot up to 859 compared with last year's 622. Total capacity shows somewhat smaller increase—because of high percentage of shop-assembled and packaged units. Authorities' consensus: growth will be moderate but steady

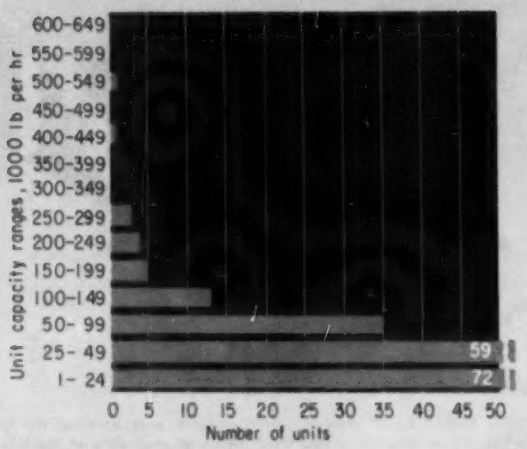
continued

HIGH-TEMPERATURE WATER



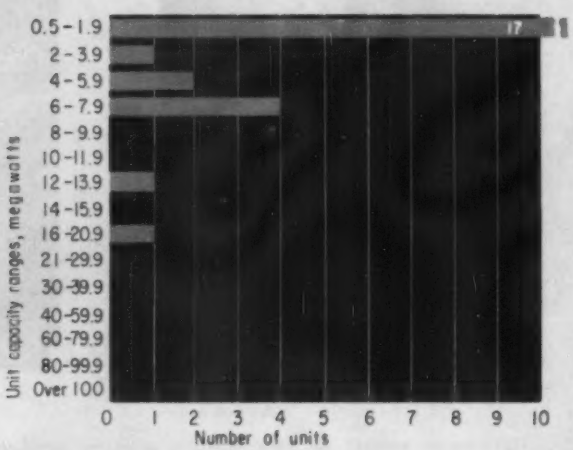
HIGH-TEMPERATURE HOT-WATER installations decreased in both number and size. Majority of units are rated below 25-M Btu per hr

BOILER SIZES



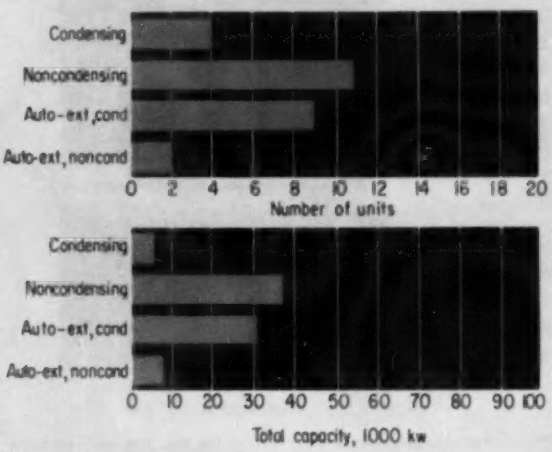
SMALLER BOILER SIZES continue to show significant gains over previous year. The smaller boilers account for 64% of total capacity

TURBINE SIZES



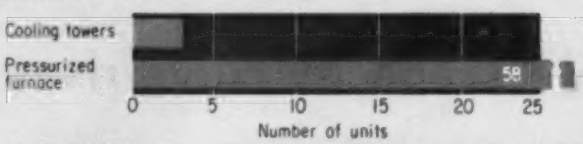
SMALLER TURBINES again account for bulk of total reported sold. This year's survey shows almost complete absence of large installations

TURBINE TYPES

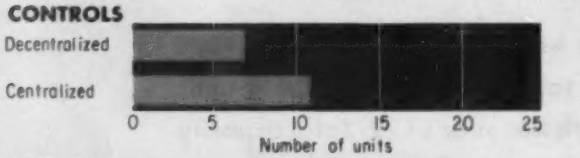


NONCONDENSING turbines overcome lead taken by auto-extraction condensing units last year, both in capacity and number of units

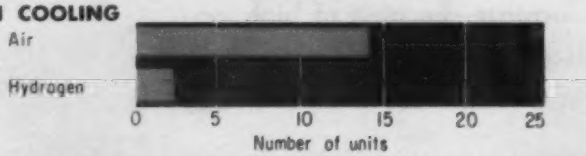
PLANT FEATURES



B-T CONTROLS

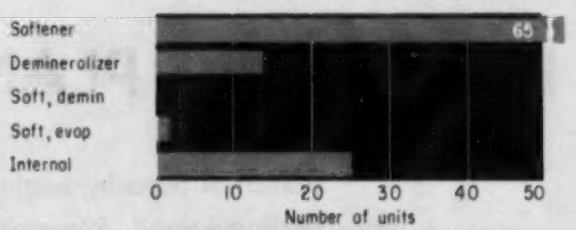


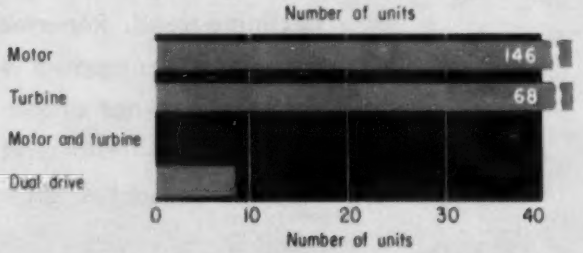
GEN COOLING



CENTRALIZED CONTROLS for boilers and turbines lead to reverse last year's trend. Pressurized firing, cooling trends remain same

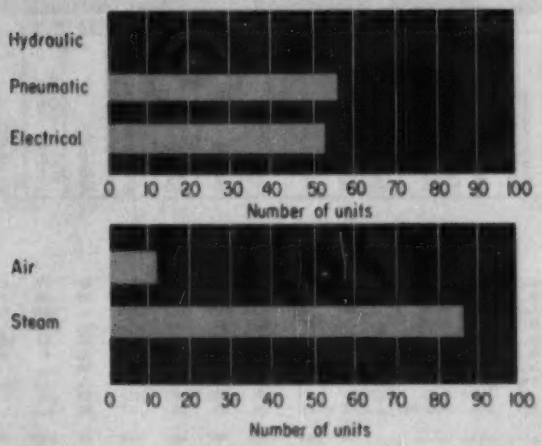
FEED TREATMENT — FEED-PUMP DRIVE





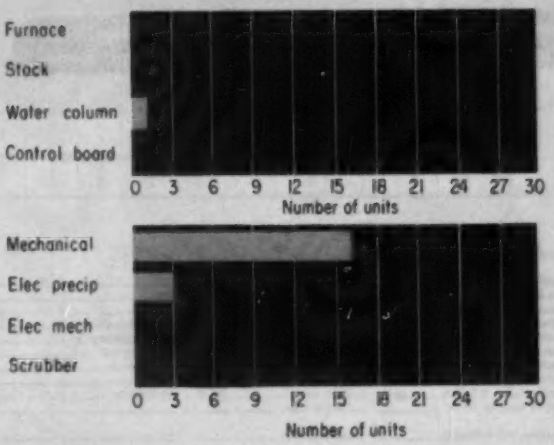
SOFTENERS still lead though internal treatment, demineralizers show gains. Motor selection for feed-pump drive has almost doubled

COMBUSTION CONTROLS — SOOT BLOWERS



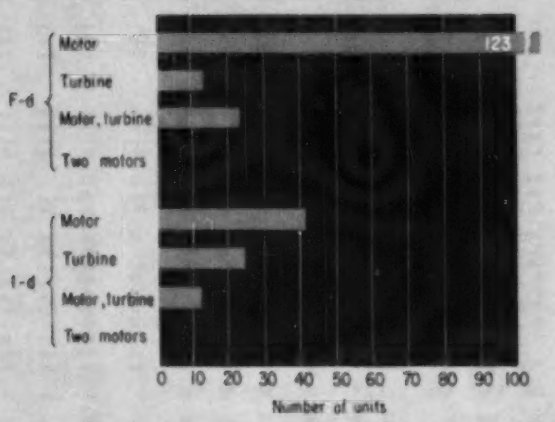
ELECTRIC COMBUSTION CONTROLS gain though pneumatic systems still lead. Ratio of steam to air for soot blowing is unchanged

TV MONITORS — DUST COLLECTORS



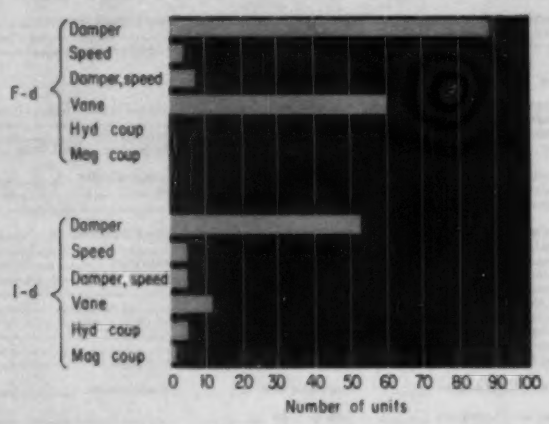
TV-MONITORING applications are less than last year; so are dust collectors because of the increase in small-boiler installations

FAN DRIVES



MOTOR-DRIVE selection for both f-d and i-d fans shows considerable increase over 1959 figures. F-d arrangement stretches its lead

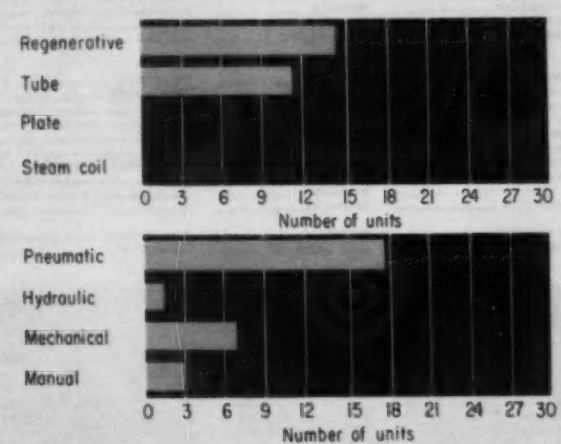
FAN CONTROLS



DAMPER CONTROL of f-d and i-d fans takes lead over vane control, reversing last year's trend. Other control types show little change

Trends in quantity and type of auxiliary equipment indicate with what impact and to what extent industry has accepted shop-assembled and packaged boilers. Significant, too, is new plant construction that makes such acceptance possible. Equipment reported in these pages was installed during the past 16 months

AIR HEATERS — ASH-HANDLING SYSTEMS



REGENERATIVE AIR HEATERS take slight lead over tubular this year. Pneumatic ash handling loses ground but still leads other methods

1960 design survey: typical industrial,

Note that each listing covers four pages. Project number helps you track a specific installation after turning facing page

Project Number	Company	Location	Consulting Engineers	New or existing plant	Date of initial operation	Principal steam use	BOILERS: No. of new boilers	Manufacturer	Operating press, psig	Operating temp, F	Boiler type	Capacity each, 1000 lb per hr	SURFACE, 1000 SQ FT: Boiler and waterwalls	Economizer	Superheater	Air heater
1500 TO 601 PSIG																
1	West Va Pulp & Paper Co	Covington, Va		Ex	1962	Po, Pr	1	CE	1500	950	WT	500	12	19	19	55
2	Int Paper Co, Southern Kraft Div	Bastrop, La	Self	Ex	10-60	Po, Pr	2	CE	1275	950	WT	225	14.1	5.9	6.8	14.3
3	Union Carbide Chemicals Co	Institute, W Va		Ex	9-60	Pr	1	CE	1000	800	WT	250	23.9	.....	4.0	43.7
4	University of Illinois	Urbana, Ill	Sargent & Lundy	Ex	1962	Po, SH	1	BW	875	760	WT	150	.....	.....	.....	.....
5	American Can Co, Marathon Div	Naheola, Ala	Rust Engineering Co	Ex	1-61	Po, Pr	1	BW	850	825	WT	181	26.3	5.5	9.8	22.0
6	Standard Oil Co of Calif	El Segundo, Calif	Fluor Corp, Ltd	Ex	8-59	Po, Pr	1	CE	850	725	WT	275	39	.....	4	.....
7	Mobay Chemical Co	Natrium, W Va	Blaw-Knox Co	Ex	7-60	Pr	1	BW	600	Sat	WT	50	4.0	2.0	.....	.....
8	Goliad Corp	Houston, Texas		New	10-60	Pr	3	TI	650	750	WT	55	4.5	.....	.....	.....
9	Bmews Station, U S Army	Clear, Alaska	Bechtel Corp	.....	7-61	Po, SH	3	EC	625	825	WT	100	11.7	3.0	2.4	9.0
10	British American Oil Ltd	Clarkson, Ont		Add	7-61	Po, Pr, SH	1	CE	625	750	WT	165	18.5	6.3	.....	.....
11	Thilmany Pulp & Paper Co	Kaukauna, Wis		.....	.....	.....	1	BW	625	830	WT	188	26.6	5.5	10.0	16.1
12	U S Industrial Chemicals Corp	Tuscola, Ill	Stone & Webster Engrg Corp	Ex	5-60	Pr	1	CE	625	750	WT	200	23.7	.....	.....	25.5
600 TO 301 PSIG																
13	Standard Oil Co of Calif	Honolulu, H I	Bechtel Corp	New	9-60	Pr	4	CE	600	600	WT	120	10.0	.....	1.3	6.4
14	Dierks Forests, Inc	Dierks, Arkansas		Ex	10-60	Po, Pr	2	BW	600	750	WT	40	4.5	.....	.....	.....
15	Adolph Coors Co	Golden, Colo		Ex	1961	Po, Pr, SH	1	UI	450	750	WT	40	3.8	.....	.....	4.3
16	Jones & Laughlin Steel Corp	Pittsburgh, Pa	Koppers Co, Inc	Ex	1-61	Pr, SH	10	CE	450	750	WT	47.2	5.8	1.8	1.1	.....
17	National Starch & Chem Corp	Indianapolis, Ind	Sargent & Lundy	Ex	7-60	.....	1	BW	440	700	WT	80	5.0	.....	0.6	11.4
18	National Starch & Chem Corp	Indianapolis, Ind	Sargent & Lundy	Ex	3-61	Pr	1	BW	440	725	WT	80	8.5	2.4	1.3	.....
19	Magnolia Petroleum Co	Beaumont, Texas		Ex	9-60	Po, Pr	1	CE	425	675	WT	250	21	N	3.3	14.8
20	A E Staley Mfg Co	Decatur, Ill	Burns & McDonnell	Ex	6-61	Po, Pr	1	RS	420	700	WT	150	18	5.4	0.6	.....
21	Georgia Pacific Paper Corp	Toledo, Ore	Stone & Webster Engrg Corp	Ex	5-60	Pr	1	CE	350	750	WT	144	.....	.....	.....	.....
22	Stokes Molded Products	Trenton, N J		Ex	9-60	Pr	1	BW	350	Sat	WT	40	3.3	.....	.....	.....
23	Wausau Paper Mills Co	Brokaw, Wis	S J Baisch Assoc	New	7-60	Pr	1	BW	325	525	WT	50	.....	.....	.....	.....
300 TO 201 PSIG																
24	Building Products Ltd	Hamilton, Ontario, Canada		Ex	1960	Pr	1	DD	300	Sat	.....	20	4.6	.....	.....	.....
25	Building Products Ltd	Pont Rouge, Quebec, Canada		Ex	1960	Pr	1	DD	200	Sat	.....	45	2.1	.....	.....	.....
26	Colorado College	Colorado Springs, Colo	Riley Engrg Corp	New	1-60	SH	2	IBW	300	380	WT	20[3]	.....	.....	.....	.....
27	Emery Industries, Inc	Cincinnati, Ohio	Frankenberger, Junker & Lensity	Ex	11-60	Pr, SH	1	RS	300	550	WT	200	21.0	.....	1.4	13.4
28	Federal Aviation Agency	Chantilly, Va	Burns & McDonnell	New	7-61	SH	2	CE	300	380	WT	30[3]	2.8	.....	.....	.....
29	Wyeth Laboratories, Inc	E Whiteland Twp, Pa	Self	New	11-60	Pr, SH	2	CE	300	390	WT	22[3]	.....	.....	.....	.....
30	Cooperative Refinery Assoc	Coffeyville, Kan		Ex	8-59	Pr	1	VO	275	460	WT	110	11.3	.....	0.2	.....
31	Food Machinery & Chemical Co	Kemmerer, Wyo	United Engrs & Constr Inc	New	8-60	Pr	1	BW	275	Sat	WT	20	2.4	.....	.....	.....
32	Colonial Sugars Co	Gramercy, La		Ex	8-60	Pr	1	UI	265	Sat	WT	80	6.7	3.5	.....	.....
33	College of Great Falls	Great Falls, Mont	Drapes Engrg	New	2-60	SH	2	IBW	250	400	WT	6[3]	0.2	0.8	.....	.....
34	Fitchburg Paper Co	Fitchburg, Mass		Ex	1-60	Po, Pr	1	BW	250	510	WT	30	2.9	.....	.....	.....
35	Glendale Sanitarium & Hospital	Glendale, Calif		Ex	7-60	SH	1	BW	250	Sat	WT	23.5	2.0	.....	.....	.....
36	Monsanto Chemical Co	Luling, La		Ex	11-58	Pr	1	VO	250	Sat	WT	28	3.2	.....	.....	.....
37	Otis Air Force Base	Falmouth, Mass		Ex	.....	SH	1	IBW	250	380	WT	31.2[3]	3.0	.....	.....	.....
38	Pantasote Co	Passaic, N J		Ex	8-60	.....	1	BW	250	Sat	WT	20	2.2	.....	.....	.....
39	Pepperell Mfg Co	Opelika, Ala		.....	12-59	Pr	1	BW	250	Sat	WT	20	.....	.....	.....	.....
40	Texas Butadiene & Chemical Corp	Channelview, Texas	Brown & Root, Inc	Ex	12-60	Pr	1	CE	250	Sat	WT	400	.....	.....	.....	.....
41	Aero Space Medical Center	Brooks A F B, Texas	Zumwalt & Vinther	New	1959	Po, SH	3	K	235	500	WT	33	.....	.....	.....	.....
42	Reilly Tar & Chemical Corp	Indianapolis, Ind		Ex	5-60	Pr	1	BW	235	Sat	WT	28	3.1	.....	.....	.....
43	Armstrong Tire & Rubber Co	Natchez, Miss		Ex	.....	Pr	1	BW	230	Sat	WT	50	6.2	.....	.....	.....
44	Midwest Steel Corp	Portage, Ind	Dravo Corp	New	.....	.....	1	EC	225	550	WT	80	.....	.....	.....	.....
45	Midwest Steel Corp	Portage, Ind	Dravo Corp	New	.....	.....	1	BW	225	550	WT	250	.....	.....	.....	.....
200 TO 151 PSIG																
46	Hillyer Deutsch Edwards, Inc	Oakdale, La	H E Bovay, Jr	Ex	.....	Po	2	BW	200[2]	Sat	WT	40	.....	.....	.....	.....
47	Princeton University	Princeton, N J	Meyer, Strong & Jones	Ex	9-60	Po, Pr, SH	1	UI	200	Sat	WT	80	6.8	2.8	0.6	.....
48	South Coast Corp	Raceland, La		Ex	10-60	Po	1	VO	200	438	WT	80	11.4	N	.....	.....
49	State Home & Training School	Plymouth, Mich		New	10-59	SH	2	UI	200[4]	Sat	WT	40	4.5	.....	.....	.....
50	U S Naval Submarine Base	New London, Conn		Ex	.....	Po	2	BW	200[5]	.....	WT	85	7.9	3.0	1.0	.....
51	Armour & Co	Bellwood, Ill	Vacudyne Corp	New	8-60	Pr	1	CB	185	Sat	FT	14.7	.....	.....	.....	.....
52	Diamond Alkali Co	Painesville, Ohio	Giffels & Rossetti	New	9-60	Pr, SH	2	OS	175	Sat	FT	11.5	2.0	.....	.....	.....
53	International Paper Co	Aldan Borough, Pa	Self	Ex	8-60	Pr	1	BW	175	Sat	WT	16	.....	.....	.....	.....
54	International Smelting & Ref Co	Perth Amboy, N J		Ex	9-60	Pr	1	BW	175	400	WT	.....	4.8	.....	.....	.....
55	Rowland Industries	Lawrence, Mass		New	.....	Pr, SH	1	YS	175	385	FT	13.8	2.0	.....	.....	.....
56	Rowland Industries	Lawrence, Mass		New	.....	Pr, SH	1	CB	175	385	FT	20	2.0	.....	.....	.....
57	Upjohn Co	Kalamazoo, Mich	Boddy, Benjamin & Woodhouse	Ex	11-60	Pr, SH	1	UI	175	Sat	WT	90	7.9	1.9	.....	.....
58	Harnischfeger Corp	Milwaukee, Wis		Ex	.....	Pr, SH	1	CE	165	450	WT	100	8.2	3.7	.....	.....
59	ACF Industries, Inc	Berwick, Pa		.....	.....	.....	1	CE	160	Sat	.....	60	.....	.....	.....	.....
60	American Oil Co	Yorktown, Va		Ex	.....	Pr	1	VO	160	Sat	WT	15	.....	.....	.....	.....
61	Titan Metal Mfg Co	Bellefonte, Pa	Henszey Associates	Ex	2-60	Pr, SH	2	K	160	Sat	WT	50	6.5	.....	.....	.....
62	American Gilsonite Co	Grand Junction, Colo	Thomas & Curtis	Ex	6-60	Pr	1	CE	155	Sat	WT	47	.....	.....	.....	.....

Add - Addition
An - Anthracite
Ba - Bagasse
BD - Balanced draft
BE - Bucket elevator
Be - Belt
BG - Gravity discharge bucket elevator
Bk - Bark
BKE - Bar and key
BL - Black liquor
Bu - Bulldozer
C - Coal, bituminous
CA - Carryall
CDS - Continuous discharge spreader
CrB - Crane & bucket
CrC - Crushed coal
CS - Car shaker
Cy - Cyclone
DB - Dry bottom
DGS - Dump grate stoker
DS - Drag scraper
El - Electrostatic
Ex - Existing
Fl - Flight
FT - Fire tube
G - Gas
Me - Mechanical
ML - Monorail larry
N - None
O - Oil
PC - Pulverized coal
Pd - Pressurized
Po - Power
Pr - Process
Re - Regenerative
RR - Railroad
Sat - Saturated
SC - Steam coil
SH - Space heat
Skip - Skip hoist
Stc - Stacking conveyor
Sw - Screw conveyor
TG - Traveling grate
TH - Track hopper
Tr - Truck
Tu - Tubular
VG - Vibrating grate stoker
VS - Venturi scrubber
Wd - Wood
WH - Waste heat

institutional power plants over 150 psi

Furnace volume 1000 cubic feet	Furnace heat release 1000 Btu per cu ft per hr	Furnace type	Air heater type	Air heater manufacturer	Dust collector type	Dust collector manufacturer	NEW FIRING EQUIPMENT: Firing	Stoker type	Grate area, sq ft	Stoker manufacturer	Heating value 1000 Btu per lb	COAL HANDLING EQUIPMENT: Delivery method to plant site	Unloading equipment	Manufacturer	Stockpiling method	Stockpile to in-plant storage	Manufacturer	Covered storage facility	Manufacturer	In-plant handling equipment	Manufacturer	Weighing equipment	Manufacturer	
33	21	DB	Re	APr	.....	.....	PC	.....	.....	.....	.....	RR	TH	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
11.9	26.4	BD	Tu	CE	Me	.....	G, Bk	CDS	299	CE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
21	17.6	BD	Tu	CE	Me, El	WP	PC	.....	.....	.....	11.1	RR, Tr	CS, TH	SA	Bu, CrB	Be	SA	Bunker	.....	Be	SA	.....	.....	3
.....	.....	BD	Tu	BW	Me	WP	C	CDS	.....	DSC	.....	RR	CS, TH	.....	Bu	Be	SA	Bunker	.....	Be	.....	Scale	RI	4
90.8	.....	Pd	Tu	BW	.....	.....	Q, BL	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
23	18	Pd	.....	.....	El	RC	Q, G, WH	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
1.0	.....	Pd	N	.....	N	.....	G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
1.63	.....	Pd	N	.....	N	.....	G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
5.2	26.8	BD	SC	AS	Me	EC	C	BKE, CDS	.....	DSC	8.5	RR	CS, TH	LB	Bu	Be, SIC	LB	Bunker	.....	Be	LB	Scale	DE	9
.....	.....	Pd	.....	.....	.....	.....	Q, G, WH	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
90.8	10.8	BD	Tu	.....	VS	BW	G, BL	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
15.8	16.4	.....	Tu	CE	Me	PD	PC, G	.....	.....	.....	.....	RR, Tr	CS, TH	LB	CA	Be	LB	.....	.....	Be	.....	.....	.....	12
1.3	52.3	Pd	Re	Apr	.....	.....	Q, G	.....	.....	.....	780[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13
.....	.....	BD	.....	.....	.....	.....	Wd, Bk	.....	.....	.....	8500[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
1.3	37	Pd	Tu	UI	.....	.....	Q, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
.....	.....	.....	.....	.....	El	KC	WH	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16
1.3	.....	.....	Re	APr	El	.....	Q, G	.....	.....	.....	18.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17
4	27.9	BD, DB	.....	.....	.....	WP	C	CDS	.....	DSC	11.7	Tr	CS, TH	SA	.....	FI	SA	.....	.....	Be, BG	SA	.....	.....	18
11.8	29.4	Pd	Re	APr	.....	.....	Q, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
8.8	20.9	BD, DB	.....	.....	.....	.....	C	BKE	520	RS	10.5	RR	CS, CrB	RO	CrB	Be	RO	.....	.....	.....	.....	.....	.....	20
.....	.....	.....	.....	.....	.....	.....	BL	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21
0.9	.....	Pd	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22
1.1	.....	.....	Re	APr	.....	.....	Q, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23
.....	.....	Pd	.....	.....	.....	.....	O	.....	.....	.....	18.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24
.....	.....	Pd	.....	.....	.....	.....	O	.....	.....	.....	18.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
.....	.....	.....	.....	.....	.....	.....	Q, G	.....	.....	.....	829[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26
13.2	15.0	DB	Re	APr	Me	AT	PC, O, Tar	.....	.....	.....	13.5	RR, Tr	TH	.....	.....	FI, Skip	.....	Bunker, Silo	.....	SW, BE	.....	.....	BM	27
0.5	.....	Pd	.....	.....	.....	.....	Q, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28
.....	.....	Pd	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29
5.5	.....	BD	Re	APr	.....	.....	Q, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30
0.6	33.2	Pd	.....	.....	.....	.....	G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31
1.38	69	Pd	.....	.....	.....	.....	G, O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32
.....	.....	.....	.....	.....	.....	.....	G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33
.....	20.5	Pd	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34
.....	.....	BD	.....	.....	.....	.....	Q, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35
.....	.....	BD	.....	.....	.....	.....	G	.....	.....	.....	1000[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36
.....	.....	BD	.....	.....	Me	PD	C	DGS	.....	RS	.....	Tr	CrB	.....	Bu, CrB	BE	FE	Silo	FE	BG	.....	Scale	FE	37
0.6	.....	Pd	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38
.....	.....	.....	.....	.....	.....	.....	O G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39
.....	.....	.....	Tu	APr	.....	.....	G	.....	.....	.....	550[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
.....	.....	.....	.....	.....	.....	.....	G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41
0.8	.....	Pd	.....	.....	.....	.....	Q, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42
1	.....	BD	.....	.....	.....	.....	G	.....	.....	.....	960[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43
.....	.....	Pd	Re, SC	.....	.....	.....	Q, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44
.....	.....	BD	Re, SC	.....	.....	.....	O, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45
.....	.....	BD	.....	.....	.....	.....	Wd, Bk	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	46
3.5	28.7	BD	.....	.....	Me	AS	C	VG	227	AE	.....	RR	CS, TH	HR	DS	Be, BE	HR	.....	.....	Be, BE	HR	Scale	BB	47
.....	.....	.....	.....	.....	N	.....	G, Ba	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48
.....	.....	Pd	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49
2.8	.....	BD	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50
.....	.....	.....	.....	.....	.....	.....	O, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	51
.....	.....	.....	.....	.....	.....	.....	G	.....	.....	.....	1200[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52
.....	.....	Pd	.....	.....	.....	.....	O, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	53
.....	.....	Pd	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	54
0.1	13.4	BD	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	55
0.2	20.7	BD	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	56
4.4	25.6	BD	.....	.....	Me	WP	C	CDS	.....	RS	12.6	RR	.....	.....	.....	Be, FI	.....	.....	.....	BE	.....	.....	.....	57
3.5	35.5	BD	.....	.....	.....	.....	C	VG	.....	AE	.....	RR, Tr	CrB, TH	CBE	CrB	CrB	HAC	.....	.....	CrB	HAC	Scale	HS	58
.....	.....	BD	.....	.....	Me	PD	An	BKE	240	CE	13.0	RR	.....	.....	.....	Skip	BB	Bunker	.....	ML	BB	.....	.....	59
.....	.....	Pd	.....	.....	.....	.....	Q, G	.....	.....	.....	16.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60
2.0	33.8	BD	.....	.....	Me	PD	C	CDS	94	DSC	12.5	RR, Tr	.....	.....	.....	BE	BB	Silo	.....	BE	BB	Scale	BS	61
.....	.....	Pd	.....	.....	.....	.....	Q, G	.....	.....	.....	1200[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	62

WT - Water tube
1 - Btu per cu ft
2 - Future 415 psig, 750 F
3 - Million Btu per hr
4 - Future 425 psig
5 - Future 650 psig
6 - Future superheat

MANUFACTURERS

AC - Allis-Chalmers Mfg Co
AE - American Engineering Co
APr - Air Preheater Corp
AS - American Standard, Ind Div
AT - Aerotec Corp
BB - Beaumont Birch Co
BS - Buffalo Scale & Mfg Co, Inc
BW - Babcock & Wilcox Co
CB - Cleaver Brooks Co
CBE - Chain Belt Co
CE - Combustion Engineering, Inc
DB - Dominion Bridge Ltd
DE - Detecto Scales, Inc
DSC - Detroit Stoker Co
EC - Erie City Iron Works
FA - Fly Ash Arrestor Corp
FE - Fairfield Engineering Co
FM - Fairbanks, Morse & Co
HAC - Harnischfeger Corp
HCC - Hagan Chemicals & Controls, Inc
HR - Hewitt-Robins, Inc
HS - Howe Scale Co
IBW - International Boiler Works
K - E Keeler Co
KC - Koppers Co, Inc
LA - Louis-Allis Co
LB - Link-Belt Co
OS - Orr & Sembower, Inc
PD - Pfaf-Daniel Corp
RC - Research-Cottrell, Inc
RI - Richardson Scale Co
RO - Robbins & Meyers, Inc
RS - Riley Stoker Corp
SA - Stephens-Adamson Mfg Co
TI - Titusville Iron Works Co
UI - Union Iron Works
VO - Henry Vogt Machine Co
WP - Western Precipitation Corp
YS - York-Shipley, Inc

Industrial power plants over 150 psi — continued

Project Number	F.D. FANS: No. and drive	F.D. FANS: Fan manufacturer	F.D. FANS: Drive manufacturer	I.D. FANS: No. and drive	I.D. FANS: Fan manufacturer	I.D. FANS: Drive manufacturer	AIR & GAS FLOW CONTROL: Air flow	AIR & GAS FLOW CONTROL: Gas flow	SOOT BLOWERS: No. per boiler	SOOT BLOWERS: Type	SOOT BLOWERS: Manufacturer	Ash handling system	Manufacturer	FEED WATER PUMPS: No. per boiler	FEED WATER PUMPS: Pump manufacturer	FEED WATER PUMPS: Drive type	FEED WATER PUMPS: Drive manufacturer	FEED WATER PUMPS: Pump control	Low water cutoff manufacturer (pkg boilers)	WATER TREATMENT: Flow rate, gpm	WATER TREATMENT: Softening	WATER TREATMENT: Demineralizing	WATER TREATMENT: Manufacturer
1	1T	AS	.....	2T	AS	.....	.....	.....	19	St	DP	.....	.....	2	.....	T	.....	.....	.....	.....	.....	De	.....
2	1M	GF	WE	1T	GF	WE	V	S	...	.....	.....	Pn	.....	1	PP	T	WE	S	.....	800	.....	Mu	PM
3	1M	SW	WEC, EL	1Du	GF	W,C	D	D	18	St	CV, DP	Hyd	UC	1,5	BP	T	WO	R	.....	1200	HLZ	.....	.....
4	1M	AS	GE	1M	GF	GE	V	Hy	6	St	DP	Pn	UC	1	IR	T	GE	.....	.....	.....	.....	Mu	PM
5	1M	CF	.....	2T	CF	WE	D	.....	22	St	DP	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	1T	AS	.....	....	....	.....	V	.....	...	St	DP	2	PP	T	.....	R	.....	R	.....	600	.....	.....	.....
7	1M	GF	FM	....	....	.....	V	.....	N	.....	.....	.....	.....	D,E	.....	.....	.....	.....	.....	.....	Z	.....	.....
8	1M	WE	.....	....	....	D	.....	.....	....	.....	.....	.....	.....	2,E	PP	T	EL	R	.....	.....	.....	Mu	PM
9	1M	BF	EL	1M	BF	EL	.....	D, Hy	9	St	CV	Pn	.....	2	IR	M	WE	S	CV	.....	.....	.....	AWS
10	2T	JH	WO	N	....	.....	V	.....	6	St	CV	.....	.....	....	.....	T	.....	R	.....	.....	HLZ	.....	.....
11	1M	CF	.....	1T	CF	WE	D	S	11	St	DP	.....	.....	3	IR, AC	M,T	.....	S	.....	150	HLZ	.....	.....
12	1M	SW	EL	1M	SW	EL	D	D	16	St	DP	Pn	UC	2	IR	M,T	.....	R	.....	.....	.....	Mu	COC
13	1Du	CF	WE,TE	N	....	.....	S,V	.....	5	St	DP	.....	.....	5	IR	2M,3T	WE,EL	S	.....	1760	HLZ	.....	GR
14	1M,1T	LJW,CT	.....	1M	....	WE	D	.....	2	St	DP	.....	.....	1	AC	Du	.....	R	.....	120	.....	.....	.....
15	1M	AS	.....	....	....	.....	.....	.....	2	St	DP	.....	.....	....	WO	T	WO	S	.....	.....	CLZ	Mi, Mu	IW
16	1	GF	.....	1T	....	EL	.....	Lo	4	St	CV	Pn	AS,H	3,11	PP	M,T	EL	R	.....	.....	.....	.....	.....
17	1M	GF	GE	N	....	.....	V	.....	4	St	DP	.....	.....	1	IR	M	GE	R	.....	.....	.....	.....	.....
18	1M	AS	GE	1	AS	GE	V	.....	7	St	DP	Pn	UC	1	IR	M	GE	R	.....	.....	.....	.....	.....
19	1T	SW	EL	N	....	.....	S	.....	N	.....	.....	.....	.....	....	8	T	.....	S	.....	.....	Hot	.....	.....
20	1M	CF	LA	1M	CF	LA	V	Ma	8	St	BA	Hyd	AS,H	Ex	.....	.....	.....	.....	.....	.....	Ca,CLZ	.....	.....
21	1M	AS	GE	1T	AS	WO	V	S	...	St	DP	.....	.....	1	WO	M	GE	R	.....	.....	HLZ	.....	.....
22	1M	GF	MA	....	....	.....	D	.....	1	St	DP	.....	.....	3	WO, DL	St, M	WO, WE	.....	BM	150	Z	.....	.....
23	1M	CF	GE	1	....	.....	.....	.....	2	St	DP	.....	.....	1	.....	M	ME	R	BM	.....	HLZ	.....	COC
24	1M	.....	.....	N	....	.....	D	.....	2	Air	DP	.....	.....	2	BW	M	.....	R	RG	.....	.....	.....	.....
25	1M	.....	.....	N	....	.....	D	.....	2	Air	DP	.....	.....	2	BW	M	.....	R	RG	.....	.....	.....	.....
26	1M	AS	GE	....	....	.....	D	.....	...	.....	.....	.....	.....	1,10	DBP	M	GE	.....	.....	.....	Z	.....	.....
27	1Du	BF	TE, WEC	1Du	BF	TE, WEC	S,V	S,D	11	St	DP	Pn	UC	2-Ex	.....	.....	.....	.....	.....	500	Ex	.....	.....
28	1M	CF	.....	....	....	.....	V	.....	...	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	25	Z	.....	.....
29	1M	CF	.....	....	....	.....	D	.....	2	Air	DP	.....	.....	1,10	WO	.....	.....	.....	MA	6	Z	.....	.....
30	1Du	WE	EL	1Du	WE	EL,WO	D	D	6	.....	DP	.....	.....	2	IR	T	IR	R	.....	560	HLZ	.....	.....
31	1M	GF	RE	N	....	.....	.....	.....	N	.....	.....	.....	.....	1	JB	M	RE	Man	.....	100	Z	Mi	PM
32	1Du	FA	TE	....	....	.....	D	.....	...	.....	.....	.....	.....	1	IR	T	TE	S	RG	.....	Ca,CLZ	.....	.....
33	1M	IF	.....	....	....	.....	.....	.....	1	Air	DP	.....	.....	....	DBP,10	.....	.....	.....	MA	.....	Z	.....	.....
34	1M	.....	WE	....	....	.....	.....	.....	1	St	DP	.....	.....	1	WPI	M	WE	.....	BM	.....	.....	.....	.....
35	1M	.....	FM	....	....	.....	.....	.....	1	St	DP	.....	.....	1	AM	St	.....	.....	MA	.....	CLZ	.....	.....
36	1M	.....	.....	1M	....	.....	V	V	1	St	BA	.....	.....	2	FM	M	.....	R	.....	.....	.....	.....	.....
37	1M	CF	AC	1M	PD	EL	V	.....	2	.....	DP	Ma	FE	2	WS	M	EL	R	.....	10	Z	.....	COC
38	1M	GF	.....	N	....	.....	V	.....	1	St	DP	.....	.....	2	DL	M,T	.....	R	RG	.....	.....	.....	.....
39	1M	.....	.....	N	....	.....	V	.....	...	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	1Du	AS	WE,WO	....	....	.....	.....	.....	...	.....	.....	.....	.....	2	PP	M,T	WE,WO	.....	.....	600	HLZ	.....	GR
41	2M, 1T	BF	.....	2M, 1T	PD	.....	V	D	2	St	CV	.....	.....	2	AC	1M,1T	.....	R	.....	.....	Z	.....	.....
42	1M	GF	FM	N	....	.....	V	.....	1	St	DP	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
43	.....	.....	.....	1Du	SW	COP	.....	D	...	.....	.....	.....	.....	1	WO	T	WO	S	.....	94	HLS	.....	.....
44	1M	BF	EL	N	....	.....	V	.....	...	St	CV	.....	.....	3,9	IR	M,T	EL,WO	S,R	.....	1000	So	.....	PM
45	1Du	BF	WO	1Du	BF	.....	V	D	...	St	DP	.....	.....	3,9	IR	M,T	EL,WO	S,R	.....	100	So	.....	PM
46	2M	.....	.....	1M	....	.....	.....	.....	2	St	.....	.....	.....	2	.....	M,T	.....	.....	.....	.....	.....	.....	.....
47	1M	AS	GE	1M	AS	GE	V	V	4	St	DP	Pn	UC	2	LC	T	EL	S	.....	.....	Z	.....	.....
48	1T	.....	.....	1T	....	.....	D	.....	...	St	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
49	1M	AS	.....	....	....	.....	D	.....	7	St	CV	.....	.....	....	PE	M	.....	.....	.....	.....	.....	Mu	PM
50	1M	BF	GE	1Du	GF	AC	D	D	4	Air	DP	.....	.....	2	PPC	M,T	ME	S	.....	.....	Z	.....	.....
51	1M	.....	.....	....	....	.....	D	.....	...	.....	.....	.....	.....	2	.....	M	.....	.....	MA	.....	CLZ	.....	.....
52	.....	.....	.....	....	....	.....	.....	.....	...	.....	.....	.....	.....	1	NYA	M	GE	.....	OS	.....	Z	.....	.....
53	1M	GF	.....	N	....	.....	V	D	2	St	DP	.....	.....	2	WO	St	.....	R	BM	.....	Z	.....	.....
54	1M	SW	.....	N	....	.....	D	.....	N	.....	.....	.....	.....	....	IR	M	GE	.....	.....	1770	Z	.....	.....
55	1M	.....	.....	N	....	.....	.....	.....	...	.....	.....	.....	.....	1	AU	M	GE	.....	MH	.....	.....	.....	HCC
56	1M	.....	.....	N	....	.....	.....	.....	...	.....	.....	.....	.....	1	AU	M	GE	.....	MH	.....	.....	.....	HCC
57	1M	CF	LA	1T	CF	WE	D	S,D	6	St	CV	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	1M	BF	LA	1M	AS	LA	V	D	10	St	DP	.....	CBE	1	IR	M	HAC	R	.....	.....	So	.....	.....
59	1M	CF	GE	1M	PD	GE	V	D	N	.....	.....	Pn	NC	2	IR	M,T	GE,EL	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	....	....	.....	.....	.....	...	.....	.....	.....	.....	....	WS	T	.....	.....	.....	.....	Z	.....	.....
61	1M	PD	WE	1M	PD	WE	D	D	2	St	CV	Pn	.....	1	.....	M,T	.....	.....	.....	.....	Z	.....	PM
62	1T	CF	EL	N	....	.....	S	.....	2	St	CV	.....	.....	....	.....	.....	.....	.....	BM	.....	.....	.....	.....

AE - Auto-extraction
Co - Coagulator
CB - Control board
Cen - Centralized
CLZ - Cold lime zeolite
Con - Condensing
Cons - Condensate
Cont - Contact
CT - Cooling tower
D - Damper
De - Demineralizer
Dec - Decentralized

Du - Dual drive
E - Electrical
Ex - Existing
Hy - Hydrogen
HLS - Hot lime soda
HLZ - Hot lime zeolite
Hy - Hydraulic coupling
Hyd - Hydraulic
J - Steam jet
Lo - Louvre
M - Motor
Ma - Magnetic coupling

Man - Manual
Me - Mechanical
MB - Mixed bed
MP - Mixed pressure
Mu - Multibed
N - None
NC - Noncondensing
Pn - Pneumatic
Pr - Process
R - Regulator
S - Speed
So - Softening

St - Steam
Su - Surface
T - Turbine
V - Vane
Z - Zeolite
7 - For 3 boilers
8 - Feedwater furnished from common feedwater system
9 - For 2 boilers
10 - High temperature water circulating pump
11 - For 11 boilers

MANUFACTURERS

AC - Allis-Chalmers Mfg Co
AM - American-Marsh Pumps, Inc
AS - American Standard, Ind Div
ASH - Allen-Sherman-Hoff Co
AU - Aurora Pump Div
AWS - American Water Softener Co
BA - The Bayer Co
GE - Betz Laboratories, Inc
BF - Buffalo Forge Co
BM - Bailey Meter Co

Compiled by: R C Beiler, Associate Editor and Alfreda Thornton

Combustion control	Control manufacturer	TURBINES												CONDENSERS					Boiler controls	Total plant boiler capacity incl new units, 1000 lb per hr	Project Number
		Number	Throttle pressure, psig	Throttle temperature, F	Manufacturer	Capacity, kw	Type	RPM	Back pressure, psia	No. of bleed points	No. of auto-extraction points	Deaerating heater pressure, psig	Generator cooling	Type	Manufacturer	No. of water passes	Cooling water source	Condensate air removal			
-----	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	-----	1
Pn	HCC	1	1250	950	GE	20,000	NC	3600	190	---	---	60	H_2	-----	-----	---	-----	---	Cen	930	2
Pn	BM	2	1000	800	GE	5000	NC	3600	415	---	---	75	Air	-----	-----	---	-----	---	Cen	1995	3
Pn	RF	1	850	760	GE	7500	AE	3600	1.5	1	1	8	Air	Su	WE	2	-----	J	Dec	620	4
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	Dec	-----	5
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	1500	6
Pn	-----	N	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	130	7
Pn	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	Su	EL	2	CT	J	-----	165	8
Pn	CV	3	600	825	GE	7000	Con, AE	3600	0.75	N	3	35	Air	-----	WO	2	Well	J	Cen	300	9
-----	-----	1	600	750	WE	4476	AE	3700	65	---	---	15	-----	-----	-----	---	-----	---	Cen	600	10
Pn	BM	3	625	825	GE	6,7.5, 15.6	Con, NC, AE	3600	-----	---	---	5	Air, H_2	Su	-----	1	River	---	Dec	600	11
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	1000	12
Pn	FX	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	525	13
Pn	BM	1	600	750	WE	1500	NC	3600	165	---	---	5	Air	Cont	AC	---	Lake	J	Cen	80	14
Pn	BM	1	400	750	WE	2500	Con, AE	3600	1.0	---	1	6	Air	Su	WE	4	River	J	Dec	180	15
Pn	HCC	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	Cont	EL	---	River	---	Cen	526	16
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	240	17
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	240	18
Pn	-----	1	MS	650	GE	12,500	NC	3600	165	---	N	-----	Air	-----	-----	---	-----	---	Cen	3100	19
Pn	HCC	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	-----	20
Pn,E	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	450	21
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	72	22
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	-----	23
E	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	25	24
E	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	120	25
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	40[3]	26
Pn	HCC	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	200	27
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	60[3]	28
Pn	HCC	N	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	44[3]	29
Pn	RF	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	280	30
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	20	31
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	234	32
E	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	16[3]	33
Hyd	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	2	-----	J	Cen	160	34
E	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	38.5	35
E	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	9.2	36
E	HC	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	93.6[3]	37
E	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	50	38
Pn	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	160	39
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	Cen, Cb	1560	40
Pn	RF	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	99	41
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	40	42
E	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	140	43
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	330	44
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	330	45
-----	-----	2	160	600	---	1500	Con, MP	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	Cb	140	46
Pn	BM	3	180	Sat	GE	1250	NC	3600	10	---	---	30	Air	-----	-----	---	-----	---	-----	190	47
Pn	RF,HC	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	300	48
-----	HC	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	80	49
Pn	HCC	1, 1	190	480	GE, EL	-----	A-E, Con	3600	5	---	1	5	Air	Su	-----	2	Ocean, River	J	-----	220	50
E	MH	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	-----	51
E	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	30.3	52
Pn	BM	N	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	26	53
-----	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	260	54
E	ECA	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	33	55
E	ECA	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	33	56
Pn	RF	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	330	57
E	HC	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	170	58
Pn	BM	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	200	59
E	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	215	60
Pn	HCC	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	125	61
-----	-----	---	-----	-----	---	-----	-----	-----	-----	---	---	-----	-----	-----	-----	---	-----	---	-----	150	62

BP - Bingham Pump Co
CBE - Chain Belt Co
CF - Clarage Fan Co
COC - Cochrane Corp
COP - Copeus Engineering Corp
CT - Carling Turbine Blower Co
CV - Copes-Vulcan Div, Blaw-Knox Co
DBP - Dean Brothers Pumps, Inc
DC - Dearborn Chemical Co
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp
ECA - Electronics Corp of America
EL - Elliott Co
FM - Fairbanks, Morse & Co
FX - The Foxboro Co
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GW - Graver Water Conditioning Co
HC - The Hays Corp
HCC - Hagan Chemicals & Controls, Inc
HL - Hall Laboratories, Inc
IF - Iron Fireman Mfg Co
IR - Ingersoll-Rand Co
IW - Illinois Water Treatment Co
JB - John Bean Div
JH - James Howden & Co of Canada Ltd
LA - The Louis-Allis Co
LC - Lacourtney Co
LJW - L J Wing Mfg Co
MA - Magnetrol, Inc
ME - Marathon Electric Mfg Corp
MH - Minneapolis-Honeywell Regulator Co
NA - National Aluminate Corp
NYA - New York Air Brake Co
OS - Orr & Sembower, Inc
PD - Pratt-Daniel Corp
PE - Peerless Pump Div, Food Machinery and Chemical Corp
PM - Permutit Co, Div of Pfaudler Permutit, Inc
PP - Pacific Pumps, Inc
PPC - Pennsylvania Pump & Compressor Co
RE - Reliance Electric & Engrg Co
RF - Republic Flow Meters Co
RG - Reliance Gage Column Co
RH - Roy E Hith Co
SW - Sturtevant Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co
UC - United Conveyor Corp
WE - Westinghouse Electric Corp
WEC - Wagner Electric Corp
WO - Worthington Corp
WP1 - Warren Pumps, Inc
WS - Wilson-Snyder Works, U S Steel Corp

1960 design survey: typical industrial,

Survey Number	Company & Location	Consulting Engineers	New or existing plant	Date of initial operation	Principal steam use	NEW BOILERS: Number new boilers	Manufacturer	Operating pressure, psig	Operating temperature, F	Boiler type	Capacity each, 1000 lb per hr	Boiler and waterwall surface, 1000 sq ft	Furnace volume 1000 cu ft	Furnace heat release, 1000 Btu per cu ft per hr	Furnace type	NEW FIRING EQUIPMENT: Firing	Stoker type	Stoker manufacturer	Heating value 1000 Btu per lb
150 TO 141 SPIG																			
63	American Standard, Trenton, N J		Ex	10-60	SH	2	BW	150	Sat	WT	28	.....	.....	.....	.....	O	.....	.....	.....
64	Art Metal - Security Div, Auburn, N J		New	1958	SH	1	BW	150	375	WT	24	.....	0.7	.....	.....	O	.....	.....	19.0
65	Ball State Teachers College, Muncie, Ind		.....	.....	.....	1	VO	150	Sat	WT	37	0.5	.....	.....	BD	C	CG	IS	12.5
66	Broadmoor Hotel, Inc, Colorado Springs, Colo	Jaros, Baum & Bolles	New	10-60	Po[3], SH	1	BW	150	465	WT	50	.....	.....	.....	BD	O,G	.....	.....	.....
67	Brown & Williamson Tobacco Corp, Louisville, Ky		Ex	.....	Pr, SH	1	VO	150	Sat	WT	100	15.2	.....	.....	BD	O,G	.....	.....	.....
68	Builders Block & Stove Co, Roswell, N Mex	Barnhart & Dwyer Eng Co	Ex	.....	Pr	1	OS	150	Sat	FT	13.8	.....	.....	.....	BD	G	.....	.....	.....
69	Bzura Inc, Keyport, N J		Ex	.....	Pr	1	K	150	Sat	WT	1.7	0.4	.....	.....	BD	O	.....	.....	.....
70	Catalin Corp of America, Thomasville, N C		Ex	11-60	Pr, SH	1	CE	150	Sat	WT	10	1.0	0.3	42	Pd	O	.....	.....	.....
71	Charmin Paper Products, Chebougan, Mich		Ex	11-60	Pr	1	BW	150	Sat	WT	65	70	.....	.....	BD	C	CG	BW	12.5
72	Christ Hospital, Cincinnati, Ohio	Fosdick & Hilmer	Ex	.....	Pr, SH	1	BW	150	Sat	WT	30.5	4.8	1.3	.....	BD	C	SR	.....	13.5
73	Container Corp of America, Tacoma, Wash		.....	6-60	Pr	1	BW	150	Sat	WT	27	.....	.....	.....	.....	G	.....	.....	.....
74	Empire-Reeves Steel Corp, Mansfield, Ohio	Loftus Engrg Corp	Ex	8-60	Pr, SH	2	BW	150	450	WT	18.6	6.9	.....	.....	.....	WH,O,G	.....	.....	.....
75	Fruitvale Canning Co, Oakland, Calif	C C Moore	Ex	7-60	Pr	1	BW	150	Sat	WT	50	.....	.....	.....	.....	G	.....	.....	.....
76	General American Trans Corp, Sharon, Pa		Ex	9-60	Pr, SH	1	BW	150	Sat	WT	30	3.1	.....	.....	Pd	O,G	.....	.....	.....
77	Hunt Foods & Industries Inc, Bayonne, N J		Ex	8-60	Pr	1	BW	150	Sat	WT	20	2	0.6	43	Pd	O	.....	.....	.....
78	Indiana University, Bloomington, Ind	Sargent & Lundy	Ex	.....	.....	2	EC	150	Sat	WT	100	11.6	.....	21.5	DB	C	BKE	HCE	.....
79	JFG Coffee Co, Knoxville, Tenn		New	12-59	Pr, SH	1	QC	150	Sat	WT	10.5	1.4	.....	.....	BD	...[10],G	UF	MkB	10.0
80	New York University, Bronx, New York		Ex	1961	.....	1	BW	150	Sat	WT	12	.....	.....	.....	BD	O	.....	.....	.....
81	Paterson State College, Wayne, N J	T Kauffeld	New	8-60	SH	...	SCI	150	Sat	WT	34	.....	.....	.....	Pd	O	.....	.....	.....
82	Pineland Hospital & Training Center, Pownal, Me	Maine Engrg Service Co	Ex	9-60	.....	1	BW	150	Sat	WT	55	6.5	1.9	30	BD	O	.....	.....	.....
83	Rhodia, Inc, New Brunswick, N J		Ex	10-59	Pr, SH	1	BW	150	Sat	WT	20	2.2	0.6	42.8	Pd	O	.....	.....	18.5
84	Rochester State Hospital, Rochester, N Y	N Y S Dept of Public Works	Ex	1961	SH	2	BW	150	Sat	WT	34.3	5.8	1.6	35.0	BD	C	MR	AE	14
85	S Dakota State College, Brookings, S Dak	Ray Roby	Ex	9-60	Po[3], SH	1	BW	150	Sat	WT	55	.....	.....	.....	BD	C,G	DGS	DSC	.....
86	West Virginia University, Morgantown, W Va	Byer, Klug, Urban & Pittenger	New	9-60	SH	2	BW	150	375	WT	50	.....	3.2	.....	BD	C	CG	BW	13.8
87	Youngstown Sheet & Tube Co, Indiana Harbor, Ind	Auburn & Assoc	Ex	1960	Pr, SH	2	BW	150	Sat	WT	28 39	3.4 4.4	.....	.....	.....	O,G	.....	.....	.....
140 TO 121 PSIG																			
88	Roxbury Carpet Co, Saxonville, Mass		Ex	9-60	Pr, SH	1	EC	140	Sat	WT	50	7.2	2.7	26.0	BD, Pd	O	.....	.....	.....
89	White Furniture Co, Mebane, N C		Ex	8-60	Pr, SH	1	BW	140	Sat	WT	24	3.3	.....	.....	BD	C,WW	UF	MkB	6.5
90	Mt Sinai Hospital, New York, N Y	Eggers & Higgins	New	1961	Pr, SH	4	CE	135	Sat	WT	50	.....	.....	.....	BD	O	.....	.....	.....
91	Nu-Method Dyeing & Processing Corp, Union City, N J	J G Berger	New	.....	Pr	1	K	135	Sat	WT	12.8	2.8	.....	.....	Pd	O	.....	.....	.....
92	Forest Products Corp, Morristown, Tenn	Good & Goodstein Inc	Ex	2-60	Pr, SH	1	QC	130	Sat	WT	22	2.7	.....	35	BD	WW	.....	MkB	6.0
93	American Sanitary Laundry, Honolulu, H I	Merrill Berkley	Ex	6-60	Pr	1	BW	125	Sat	WT	20	2.2	.....	.....	.....	O	.....	.....	.....
94	Armco Steel Corp, Middletown, Ohio		Ex	9-60	Pr, SH	1	BW	125	Sat	WT	50	5.9	1.7	.....	BD	O,G	.....	.....	18.4
95	Associated Industries Realty Inc, Webster, Mass		Ex	8-60	SH	1	OS	125	Sat	FT	20	.....	.....	.....	Pd	.....	.....	.....	.....
96	Brown University, Providence, R I	Buertel Co	New	9-60	SH	1	BW	125	Sat	WT	28	2.9	0.7	.....	.....	G	.....	.....	.....
97	Chesapeake & Ohio Railway Co, Clifton Forge, Va	Self	New	11-60	SH	1	WI	125	Sat	WT	60	7.8	.....	28	BD	C	CDS	.....	13.5
98	Chesapeake & Ohio Railway Co, Clifton Forge, Va	Self	New	11-60	SH	1	WI	125	Sat	WT	31	4.6	.....	37.6	BD	C	UF,SR	.....	13.5
99	Colorado State University, Fort Collins, Colo	Riley Engrg Corp	Ex	9-60	SH	1	UI	125	Sat	WT	67	.....	.....	.....	BD	G	.....	.....	.....
100	Coyne Industrial Laundry, Syracuse, N Y		.....	.....	Pr	1	CB	125	Sat	FT	12.1	.....	.....	.....	.....	O	.....	.....	.....
101	Dana Corp, Pottstown, Pa	Wertz Engrg Co	Ex	.....	.....	3	SCI	125	Sat	FT	31	3.0	.....	.....	.....	O	.....	.....	.....
102	Emge Packing Co, Inc, Anderson, Ind		Ex	1960	Pr, SH	1	BW	125	Sat	WT	30	2.3	0.9	.....	Pd	O,G	.....	.....	.....
103	Good Samaritan Hospital, Suffern, N Y	Cucci, Lanier & Levy	Ex	.....	Pr, SH	2	K	125	Sat	WT	...	2.5	.....	.....	BD	O	.....	.....	.....
104	Greeley Capitol Packing, Inc, Greeley, Colo		New	1-60	Pr, SH	2	K	125	Sat	WT	21	0.5[9]	0.5	34.5	Pd	G,O[5]	.....	.....	.....
105	Tom Huston Peanut Co, Columbus, Ga		Ex	6-60	Pr, SH	1	BW	125	Sat	WT	20	3.5	.....	30	BD	.....	.....	MkB	8.0
106	Keyes Fibre Co, Waterville, Me		Ex	11-60	Pr	1	BW	125	Sat	WT	39	4.3	1.3	30	BD	O	.....	.....	.....
107	Leclerc Institution, St Vincent de Paul, Que, Canada		New	1-60	SH	3	DB	125	463	FT	...	5.0	.....	.....	BD	C	DGS	FWI	14.0
108	E S Magee Hospital, Pittsburgh, Pa	Voohees, Wacker, Smith, Smith & Haines	Ex	1-61	Po, Pr, SH	2	BW	125	Sat	WT	25	.....	.....	.....	.....	C	UF	DSC	.....
109	Mound Park Hospital, St Petersburg, Fla	Krauss Air Conditioning, Inc	Ex	7-60	Pr, SH	1	TI	125	Sat	WT	5.2	1.5	.....	.....	BD	O	.....	.....	.....
110	North Carolina Furniture Inc, Statesville, N C		Ex	11-59	Pr, SH	1	BW	125	Sat	WT	24	3.5	.....	35	BD	C,WW	UF	MkB	13.5
111	Ottawa General Hospital, Ottawa, Ontario, Canada	Interprovincial Consultants Ltd	New	9-59	Po, Pr, SH	3	BW	125	Sat	WT	25	.....	.....	Pd	.....	O,G	.....	.....	.....
112	Ozark Smelting & Mining Co, Coffeyville, Kan		.....	.....	.....	2	CE	125	Sat	WT	20	1.8	.....	.....	Pd	O,G	.....	.....	.....
113	Pueblo Ordinance Depot, Pueblo, Colo		Ex	.....	Po	1	K	125	Sat	WT	12	0.5[9]	0.6	.....	Pd	C	DGS	FLE	10
114	The Valley Hospital, Ridgewood, N J	Sears & Kopf	New	7-60	Pr, SH	2	K	125	Sat	WT	10	.....	.....	.....	Pd	O	.....	.....	.....
115	Wyckoff Steel Co, Ambridge, Pa		New	2-60	Pr, SH	1	VO	125	Sat	WT	26	28.3	.....	.....	.....	O,G	.....	.....	.....
116	208 S La Salle St Corp, Chicago, Ill	Pioneer Service & Engrg Co	Ex	6-60	SH	2	BW	125	Sat	WT	40	.....	.....	.....	Pd	O,G	.....	.....	.....
120 TO 100 PSIG																			
117	Concordia Teachers College, River Forest, Ill	Perkins & Will	New	.....	SH	3	CE	120	Sat	WT	15[7]	1.1	0.2	72	.....	O,G	.....	.....	.....
118	General Am Tank Storage Terminal, Bedford Park, Ia		Ex	10-59	Pr	1	VO	120	Sat	WT	25	2.8	0.7	.....	Pd	O,G	.....	.....	14.4
119	N D de Wassissini, Village des Peres, Que, Canada		Ex	8-59	Pr, SH	1	CB	120	Sat	FT	10	.....	.....	.....	Pd	O	.....	.....	.....
120	Reed College, Portland, Oregon	J Donald Kroecker	Ex	.....	SH	1	K	120	Sat	WT	14	1.5	0.4	49	Pd, DB	O	.....	.....	.....
121	Mercy Hospital, Wilkes Barre, Pa	Geo E Yundt, Assoc	Ex	5-60	SH	3	K	115	Sat	WT	10	2.5	0.6	22	BD	An	HF	.....	11.5
122	Welborn Memorial Baptist Hospital, Evansville, Ind	Schmidt, Garden & Erikson	New	8-60	Pr, SH	1	BW	115	Sat	WT	12	1.5	0.4	.....	Pd	O,G	.....	.....	1020[4]
123	Chrysler Corp, Syracuse, N Y	A Kahn & Assoc	New	7-60	Pr, SH	2	BW	100	Sat	WT	30	3.1	0.8	44.3	Pd	O,G	.....	.....	19.5
124	Continental Can Co, Chicago, Ill	Schmidt, Garden & Erickson	Ex	11-60	SH	1	CE	100	Sat	WT	16	1.3	19	.....	Pd	O,G	.....	.....	.....
125	Hawaii State Hospital, Kaneoke, Oahu, H I	Wm Brisbane	New	.....	.....	2	CB	100	375	FT	20.7	3.0	.....	.....	.....	O	.....	.....	.....
126	Minonk Dairy Products, Minonk, Ill		Ex	.....	Pr	2	BW	100	Sat	WT	17.8	.....	0.5	.....	BD	O	.....	.....	.....
127	Mt Vernon High School, Mt Vernon, Ind	Jerome Richardson & Assoc	New	9-60	Pr, SH	2	BW	100	Sat	WT	7.6[7]	1.1	0.3	.....	Pd	O	.....	.....	.....
128	Quaker Oats Co, Pascagoula, Miss		Ex	4-60	Pr	1	BW	100	Sat	WT	20	2.2	0.6	.....	Pd	O,G	.....	.....	.....
129	Simonds Saw & Steel Co, Lockport, N Y		Ex	8-60	Pr, SH	2	BW	100	Sat	WT	21	2.5	0.6	.....	Pd	O,G	.....	.....	.....
130	Tennessee School for the Deaf, Knoxville, Tenn	Albert F G Bedinger	Ex	11-60	SH	1	BW	100	Sat	WT	24	3.8	9.4	.....	BD	C	UF	FLE	13.7
131	Western Electric Co, Winston-Salem, N C		Ex	1-60	Pr, SH	1	BW	100	Sat	WT	30	.....	0.9	40	Pd	O,G	.....	.....	.....
132	General Chemical Div, Baton Rouge, La		.....	9-60	Pr	1	CB	.....	.....	WT	13	1.75	.....	.....	.....	G	.....	.....	.....

An - Anthracite
BD - Balanced Draft
BE - Buttell elevator
Be - Belt
BKE - Bar and key
C - Coal, Bituminous
Ca - Classifier
CDS - Continuous discharge stoker
CG - Chain grate stoker
CLZ - Cold flow zeolite
CrB - Crane and bucket
DB - Dry bottom
DGS - Dump grate stoker
Du - Dust
E - Electrical
Ev - Evaporator
Ex - Existing plant or equipment
Fl - Flight
FT - Fire tube
G - Gas
HF - Hand fired
H-L - High-low
HLZ - Hot lime zeolite
Hyd - Hydraulic
Lo - Louvre
M - Motor
Me - Mechanical
ML - Monorail larry
MR - Multiple retort
N - None
O - Oil
PC - Pulverized coal
Pd - Pressurized
Pn - Pneumatic
Po - Power
Pr - Process
R - Regulator
RR - Railroad
S - Speed
Sat - Saturated
SH - Space heat
Skip - Skip hoist
So - Softening
SR - Single retort
St - Steam
Sw - Screw conveyor
T - Turbine
Tr - Truck
Tu - Tubular
UF - Underfeed
VG - Vibrating grate
WH - Waste heat
WT - Water tube
WW - Wood waste

Z - Zeolite softening
1 - Two turbines, 625 kw each
2 - Three for two boilers
3 - Two turbines, 350 and 700 kw
4 - Btu per cu ft
5 - Peanut hulls
6 - Three for six boilers
7 - Million Btu per hr
8 - High temperature water pumps
9 - Radiant heating surface
10 - Spent coffee grounds

MANUFACTURERS

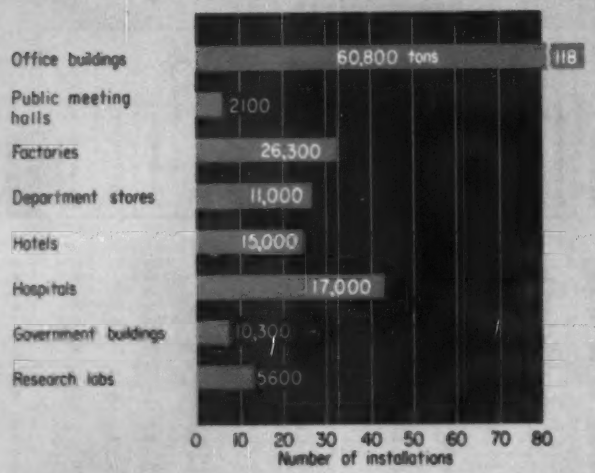
AC - Allis-Chalmers Mfg Co
AE - American Engineering Co
AM - American Marsh Pumps, Inc
AS - American Standard, Ind Div
AU - Aurora Pump Div
BA - The Bayer Co
BB - Beaumont Birch Co
BBC - Bayley Blower Co
BCC - Brady Conveyors Corp
BE - Betz Laboratories, Inc
BEC - Bahnor Electric Co
BF - Buffalo Forge Co
BM - Bailey Meter Co
BS - Buffalo Scale & Mfg Co, Inc
BW - Babcock & Wilcox Co
CB - Cleaver Brooks Co
CBC - Chicago Blower Corp
CBE - Chain Belt Co
CC - Coen Co
CCI - Cleveland Controls Inc
CE - Combustion Engineering, Inc
CEN - Century Electric Co

institutional power plants under 150 psi

COAL HANDLING EQUIPMENT				F.D. FANS			I.D. FANS			AIR & GAS FLOW CONTROL		SOOT BLOWERS			FEED WATER PUMPS						WATER TREATMENT				
Delivery method to plant site	Stockpile to in-plant storage	In-plant handling equipment	Manufacturer	No. and drive	Fan manufacturer	Drive manufacturer	No. and drive	Fan manufacturer	Drive manufacturer	Air flow	Gas flow	No. and type per boiler	Manufacturer	Ash handling system	Number per boiler	Pump manufacturer	Drive type	Drive manufacturer	Pump control	Low water cutoff and control manufacturer	Type	Manufacturer	Combustion control	Control manufacturer	Total plant boiler capacity 1000 lbs per hr	
.....	.....	.....	.....	1	LJW	.....	.....	.....	.....	.....	.....	1St	DP	.....	1	WO	Du	.....	S	.....	Z	PM	Pn	BM	26	63
.....	.....	.....	.....	1M	GF	FM	.....	.....	.....	V	.....	1	DP	.....	2	BF	M	GE	R	MA	Z	Pn	BM	.....	48	64
RR,Tr	BE	Sw,BE	FE	1Du	CF	AC	N	.....	.....	.....	.....	5St	DP	Pn	1	DHP	T	DHP	R	.....	.....	.....	Pn	BM	.....	65
.....	.....	.....	.....	1M	BF	.....	1M	AS	.....	.....	.....	.....	.....	.....	1	BF	T	COP	.....	.....	.....	.....	Pn	HCC	75	66
.....	.....	.....	.....	1M	CBC	WE	.....	.....	.....	D	.....	5St	DP	.....	...	.....	.....	.....	.....	.....	.....	.....	Pn	HCC	170	67
.....	.....	.....	.....	1	.....	.....	.....	.....	.....	D	.....	.....	.....	.....	2	AU	M	.....	.....	MM	Z	.....	E	.....	13.8	68
.....	.....	.....	.....	1M	.....	FM	N	.....	.....	D	.....	1	DP	.....	1	AU	M	AC	R	MA	.....	.....	E	CC	26	69
.....	.....	.....	.....	1M	.....	.....	N	.....	.....	D	.....	2St	CV	.....	2	AU	M	.....	R	CV	Ca,Z	.....	E	.....	15	70
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tr	.....	.....	.....	1M	CF	.....	1M	BF	.....	D	.....	4St	DP	Me	...	.....	.....	.....	.....	.....	Z	.....	.....	.....	.....	71
Tr	Be,FI, Skip	.....	.....	1M	BF	DEL	N	.....	.....	V	.....	2St	DP	.....	1	Ex	.....	.....	.....	.....	Z	COC	.....	HCC	78.5	72
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	2	GP	M	.....	R	BW	So	.....	E	.....	.....	73
.....	.....	.....	.....	.....	.....	.....	1M	SW	IE	.....	S,Lo	3	DP	.....	2	DL	M,T	WE,EL	R	.....	CLZ	.....	Pn	BM	.....	74
.....	.....	.....	.....	1M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	T	.....	Hyd	.....	Z	.....	.....	.....	.....	75
.....	.....	.....	.....	1M	GF	.....	.....	.....	.....	D	.....	1St	DP	.....	3	AU,GA	M	.....	R	RG	Z	.....	Pn	BM	60	76
.....	.....	.....	.....	1M	.....	FM	.....	.....	.....	.....	.....	1St	DP	.....	1	IR	T	COP	S	.....	Z	.....	E	CC	55	77
RR	Be	BE	GI	1T	AS	.....	1T	AS	.....	V	D	.....	DP	Pn	1	IR	M	.....	R	.....	CLZ	COC	E	HC	380	78
.....	.....	.....	.....	1M	CF	WE	1M	FA	WE	D	D	N	.....	.....	2	AM	M	WE	R	CV	.....	.....	E	CCI	12.0	79
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2St	.....	.....	1	GP	T	TE	S	BM	.....	.....	Pn,E	BM	.....	80
.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	3St	DP	.....	3	WO	M	.....	.....	.....	.....	.....	E	.....	88	81
.....	.....	.....	.....	1T	LJW	.....	1T	AS	.....	.....	D	2St	DP	.....	2	AM	M,T	EL	R	.....	Ev	COC	Pn	BM	108	82
.....	.....	.....	.....	1M	GF	FM	.....	.....	.....	V	.....	1St	DP	.....	2	IR	M	.....	R	BM,RG, MA	Z	.....	Pn	BM	28	83
Tr	.....	Sw,FI,BE	PB	1T	CF	COP	N	.....	.....	V	.....	6St	DP	Me	...6	WPM	M,T	RE,TE	S	.....	.....	.....	Pn	BM	200	84
Tr	.....	Sw,BE	.....	1M	.....	.....	1M	.....	.....	D	D	2	DP	Me	4	AM,IR	M,T	.....	.....	.....	.....	.....	.....	.....	145	85
Tr	BE	FI	FE	1Du	SW	WE	1Du	SW	WE,COP	S,D	D	1St	DP	Pn	2	RH	T	COP	S	.....	Ca	HCC,PM	Pn	BM	100	86
.....	.....	.....	.....	1M	LJW	.....	N	.....	.....	V	.....	1Air	DP	.....	...	.....	.....	.....	.....	RG	HLZ	.....	Pn	BM	2300	87
.....	.....	.....	.....	1M	CF	GE	N	.....	.....	D	.....	3St	CV	.....	...	.....	.....	.....	.....	.....	.....	.....	Pn	HCC	100	88
RR	Sw	Sw	.....	1M	CF	WE	1M	FA	WE	.....	D	Z	CV	.....	2	AM	M	WE	.....	.....	.....	.....	Pn	CV	47	89
.....	.....	.....	.....	1Du	.....	.....	.....	.....	.....	D	.....	3St	.....	.....	1	.....	M,T	.....	.....	.....	.....	.....	Pn	.....	200	90
.....	.....	.....	.....	2M	WNB	LE	.....	.....	.....	D	.....	1St	CV	.....	1	IR	M	GE	R	MA	.....	.....	E	WNB	.....	91
.....	.....	.....	.....	1M	CF	WE	1M	FA	WE	D	.....	N	.....	.....	2	AM	M	WE	R	.....	.....	.....	E	CCI	30	92
.....	.....	.....	.....	1M	GF	.....	.....	.....	.....	V	.....	1St	DP	.....	2	AU	M	.....	.....	MA	.....	.....	Pn	BM	33	93
.....	.....	.....	.....	1T	LJW	LJW	1T	SW	COP	S	D	2St	DP	.....	...	.....	.....	.....	.....	.....	.....	.....	Pn	RF	125	94
.....	.....	.....	.....	1M	CBC	EL	.....	.....	.....	D	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	E	ECA	30	95
.....	.....	.....	.....	1M	GF	FM	.....	.....	.....	V	.....	1	DP	.....	2	WPI	.....	.....	.....	.....	.....	.....	Pn	.....	.....	96
RR	BE	Be	.....	1	.....	.....	1M	.....	.....	D	D	4St	.....	Pn	1	.....	.....	.....	R	.....	Z	.....	E	.....	91	97
RR	BE	Be	.....	1	.....	.....	1M	.....	.....	D	D	2St	.....	Pn	1	.....	.....	.....	R	.....	Z	.....	E	.....	91	98
.....	.....	.....	.....	1M	AS	CEN	1	AS	CEN	D	D	St	DP	.....	1	WO	T	TE	R	.....	.....	.....	Pn	BM	167	99
.....	.....	.....	.....	M	.....	.....	M	.....	.....	.....	.....	.....	.....	.....	2	FS	M	.....	R	FS	Z	.....	.....	ECA	20	100
.....	.....	.....	.....	1M	.....	GE	.....	.....	.....	.....	.....	.....	.....	.....	1	AU	M	.....	.....	MM	Z	.....	E	HC	50	101
.....	.....	.....	.....	1M	GF	.....	.....	.....	.....	D	.....	1St	DP	.....	1	PPD	M	.....	R	.....	Z	.....	Pn	BM	45	102
.....	.....	.....	.....	.....	.....	.....	1M	LJW	BEC	.....	.....	1St	.....	.....	1	FS	M	EL	.....	MM	.....	.....	E	ECA	215	103
.....	.....	.....	.....	1M	CF	LA	N	.....	.....	.....	V	Z	CV	.....	...	FS	.....	.....	.....	MA	Z	HCC	E	CC	42	104
.....	.....	.....	.....	1M	CF	WE	1M	FA	WE	D	.....	.....	.....	.....	2	Ex	M	.....	.....	.....	.....	.....	E	CCI	40	105
.....	.....	.....	.....	1M	BF	.....	N	.....	.....	D	.....	Z	DP	.....	1	.....	M	.....	.....	.....	.....	.....	Pn	BM	120	106
Tr	Be	Be,BE	.....	1Du	SW	.....	.....	.....	.....	V	.....	2St	CV	Pn	3	.....	Du	CT	S	.....	Z	.....	Pn	RF	56	107
Tr	Co,BE	Sw,BE	COL	1M	HG	WE	.....	.....	.....	V	.....	1St	BA	Pn	1	WO	.....	WE	R	.....	Z	PM	E	HC	75	108
.....	.....	.....	.....	1M	LJW	.....	1M	LJW	.....	V	.....	4St	CV	.....	2Ex	.....	.....	.....	.....	.....	Z	.....	E	.....	.....	109
RR	Sw	Sw	MCB	2M	CF	WE	1M	FA	WE	D	.....	4St	CV	.....	2	AM	M	WE	R	.....	.....	.....	E	CCI	35	110
.....	.....	.....	.....	1M	.....	.....	.....	.....	.....	D	D	1St	DP	.....	1	.....	St	.....	.....	.....	So	.....	E	BM	75	111
.....	.....	.....	.....	1M	CF	.....	.....	.....	.....	V	.....	.....	.....	.....	2	WO	M	GE	R	CV	Z	.....	E	PE	40	112
Tr	Co	Co	.....	1M	CF	LA	.....	.....	.....	.....	.....	1St	DP	.....	...	.....	.....	.....	.....	MA,FS	.....	.....	E	HC	36	113
.....	.....	.....	.....	1M	CF	.....	.....	.....	.....	D	.....	1St	CV	.....	1	WPM	M	HEM	.....	MA	.....	.....	E	CCI	20	114
.....	.....	.....	.....	1M	CC	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	AC,GP	M	.....	.....	RG,CV	Z	.....	.....	.....	45	115
.....	.....	.....	.....	1M	GF	FM	N	.....	.....	D	.....	2St	DP	.....	2	.....	M	.....	S	BM	.....	.....	.....	BM	.....	116
.....	.....	.....	.....	1M	CF	GE	N	.....	.....	V	.....	2Air	DP	.....	2[8]	BF	.....	.....	.....	.....	Z	.....	E	TS	45[7]	117
.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	IR	M	WE	R	.....	.....	.....	.....	.....	35	118
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	VC	M	LN	.....	MM	.....	.....	.....	ECA	21	119
.....	.....	.....	.....	1M	.....	.....	N	.....	.....	V	.....	1	CV	.....	...	.....	.....	.....	.....	.....	.....	.....	E	CC	.....	120
Tr	.....	.....	.....	1M	.....	.....	N	.....	.....	D	.....	1St	DP	.....	1	FP	M,T	.....	.....	.....	.....	.....	.....	.....	35	121
.....	.....	.....	.....	1M	.....	.....	.....	.....	.....	V	.....	1St	DP	.....	2	IR	M,T	GE,COP	.....	.....	.....	.....	E	.....	24	122
.....	.....	.....	.....	1M	GF	FM	N	.....	.....	D	.....	1Air	DP	.....	...2	BF	2M,1T	AC,TE	.....	RG,MA, BM	.....	PM	Pn	BM	60	123
.....	.....	.....	.....	1M	BF	.....	N	.....	.....	V	.....	2St	DP	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	64	124
.....	.....	.....	.....	1M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...	CEN	M	.....	H-L	MM	.....	.....	E	ECA	20.7	125
.....	.....	.....	.....	1M	BBC	.....	1	.....	.....	V	.....	1St	BW	.....	2	PPD,WO	M	.....	R	MA	Ca	.....	Pn	BM	35.6	126
.....	.....	.....	.....	1M	LJW	.....	.....	.....	.....	V	.....	1Air	DP	.....	...	.....	.....	.....	.....	.....	.....	.....	E	TS	15.1[7]	127
.....	.....	.....	.....	1M	LJW	.....	.....	.....	.....	V	.....	1St	.....	.....	1	WO	M	.....	R	BM	.....	.....	Pn	BM	27.5	128
.....	.....	.....	.....	1M	CF	.....	N	.....	.....	V	.....	1St	DP	.....	1	AC	M,T	COP	.....	MA,BM	CLZ	.....	Pn	BM	42	129
.....	.....	.....	.....	1M	CF	WE	N	.....	.....	D	.....	2St	CV	.....	2	AM	M	GD	R	.....	Z	.....	Pn	CV	36	130
.....	.....	.....	.....	1M	GF	FM	N	.....	.....	V	.....	N	.....	.....	2	WO	St,M	AM	.....	.....	.....	.....	E	RIM	60	131
.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	M,T	.....	.....	.....	.....	.....	.....	.....	.....	132

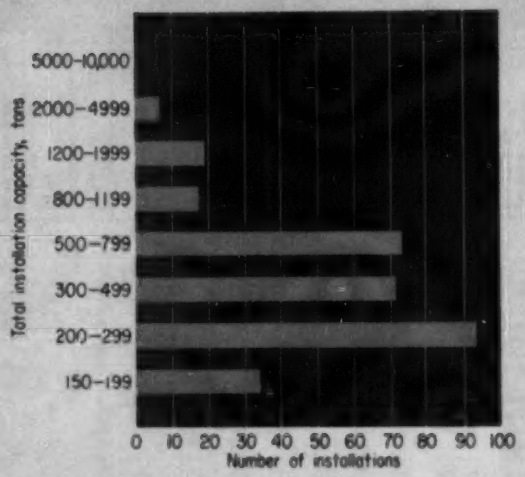
CF - Clarage Fan Co
COL - Columbus Conveyor Co
COP - Coppus Engineering Corp
CT - Carling Turbine Blower Co
CV - Copes-Vulcan Div, Blaw-Knox Co
DB - Dominion Bridge Ltd
DCC - Dearborn Chemical Co
DEL - Sinico Products Div
DHP - Dean Hill Pump Co
DL - Delaval Steam Turbine Co
DP - Diamond Power Specialty Corp
DSC - Detroit Stoker Co
EC - Erie City Irons Works
ECA - Electronics Corp of America
EL - Elliott Co
FA - Fly Ash Arrestor Corp
FE - Fairfield Engineering Co
FGH - Frank G Hough Co
FLE - Flynn & Emrich Co
FM - Fairbanks, Morse & Co
FP - Federal Pump Corp
FS - Fred H Schaub Engrg Co
FWL - Foster Wheeler Ltd
GA - Gardener-Denver Co
GD - General Dynamics Corp
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GI - Gifford-Wood Co
GP - Goulds Pumps Inc
HAC - Harnischfeger Corp
HC - The Hays Corp
HCC - Hagan Chemicals & Controls Inc
HCE - Hoffman Combustion Engrg Co
HEM - Hewitt Electric Motors Co
HL - Hall Laboratories, Inc
HS - Howe Scale Co
IE - Ideal Electric & Mfg Co
ILG - Ilg Electric Ventilating Co
IR - Ingersoll-Rand Co
IS - Illinois Stoker Co
K - E Keeler Co
LA - The Louis Allis Co
LB - Link-Belt Co
LE - Lima Electric Motor Co, Inc
LJW - L J Wing Mfg Co
LN - Leland-Newman
MA - Magnetrol Inc
McB - McBurney Stoker & Equipment Co
MH - Minneapolis-Honeywell Regulator Co
MN - McDonnell & Miller, Inc
NYA - New York Air Brake Co
OS - Orr & Sembower, Inc
PB - Palmer-Bee Co
PD - Pratt-Daniel Corp
PE - Peabody Engineering Corp
PM - Permutit Co, Div of Pfaudler Permutit, Inc
PPD - Peerless Pump Div, Food Machinery & Chemical Corp
QC - Queen City Engrg Co
RE - Reliance Electric & Engrg Co
RF - Republic Flow Meters Co
RG - Reliance Gage Column Co
RH - Racine Hydraulics & Machy, Inc
RIM - Reliance Instrument Co
RS - Riley Stoker Corp
SCI - Superior Combustion Industries, Inc
SW - Sturtevant Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co
TI - Titusville Iron Works Co
TS - Todd Shipyards Corp, Products Div
UC - United Conveyor Corp
UI - Union Iron Works
VC - Viking of Canada, Ltd
VO - Henry Vogt Machine Co
WE - Westinghouse Electric Corp
WI - Wickes Boiler Co
WNB - W N Best Combustion Equipment Co
WO - Worthington Corp
WP - Western Precipitation Corp
WPI - Warren Pumps, Inc
WPM - Weinman Pump Mfg Co
WS - Wilson-Snyder Works, U S Steel Corp
YS - York-Shipley, Inc

WHERE UNITS ARE INSTALLED



REPORTED SALES of industrial air-conditioning installations show office buildings taking 42%, industrials up to 18% of total tonnage

TONNAGE RANGE

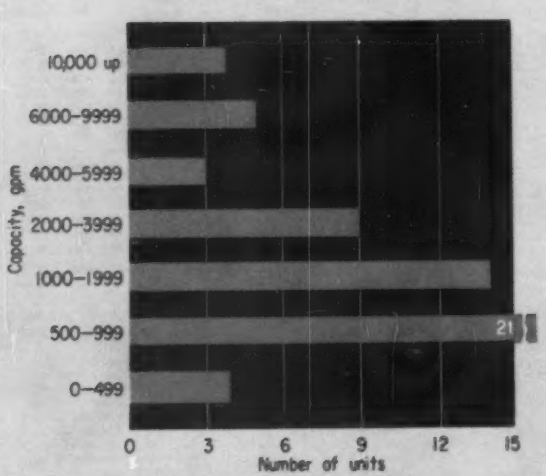


TOTAL CAPACITY range dropped, with no 5000-ton systems installed. Jobs of 800 tons and up account for 13% of installations reported

AIR CONDITIONING: industrials still climbing

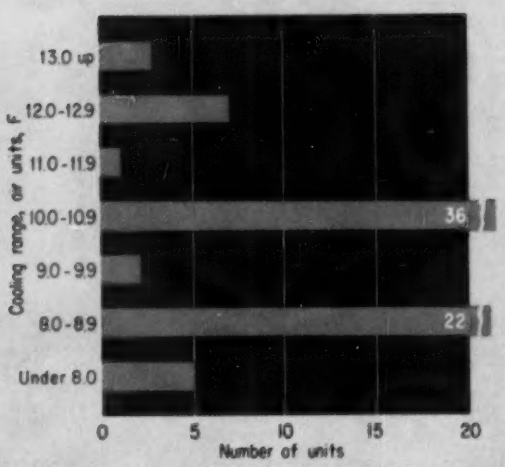
POWER'S second air-conditioning survey shows office buildings continuing to take biggest chunk of cooling. Industrial-plant conditioning keeps right on growing at a healthy rate, with potential undiminished. Schools and universities turn to cooling as one way to improve learning environment. These are two areas to watch closely as future growth modifies cooling trends

COOLING-TOWER SIZES



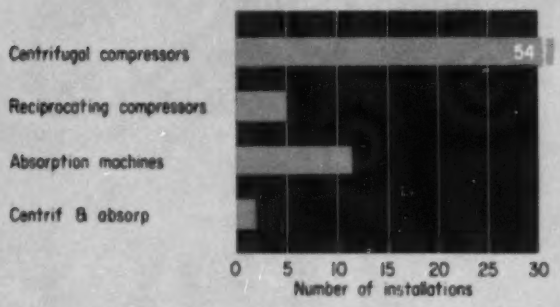
TOWER CAPACITIES rose above 10,000 gpm per tower. Distribution of sizes basically duplicates system tonnage figures charted above

HEAT-TRANSFER RANGE



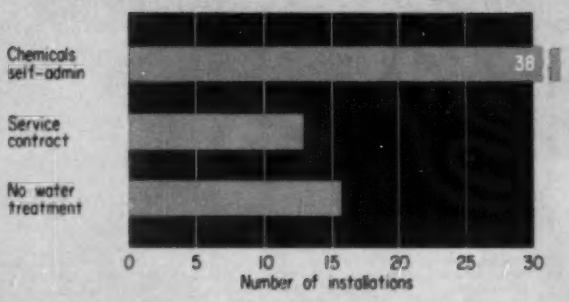
TEN-DEGREE temperature rise of water through cooling coils still retains favor as design factor, but low ranges start to see new use

REFRIGERANT-MACHINE TYPES



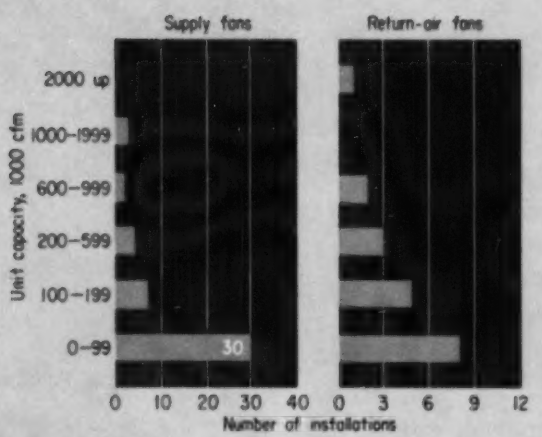
LARGE LEAD of centrifugals stems from survey's 150-ton minimum-size requirement. Absorption units continue to gain in popularity

WATER TREATMENT



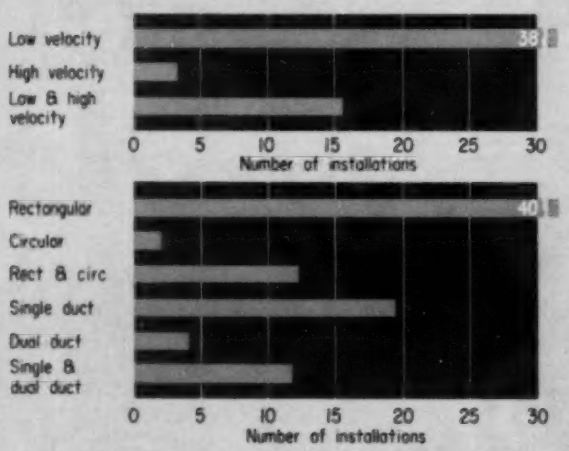
SELF-ADMINISTERED water treatment maintains 3-to-1 lead over letting out service contracts. About 25% reported no treatment at all

FAN SIZES



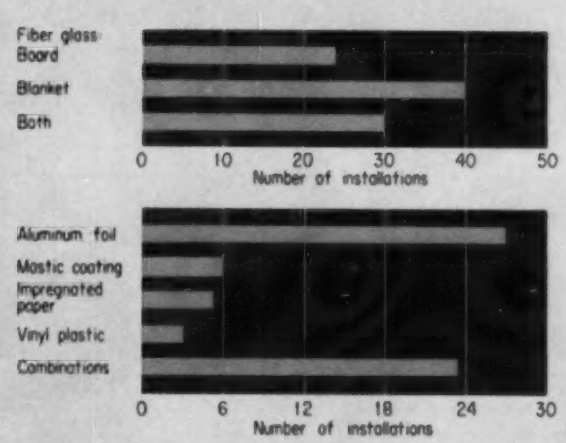
PRESSURIZED SYSTEMS still lead in units installed. Small fans indicate continued use of multizoned systems for control flexibility

DUCT SYSTEM



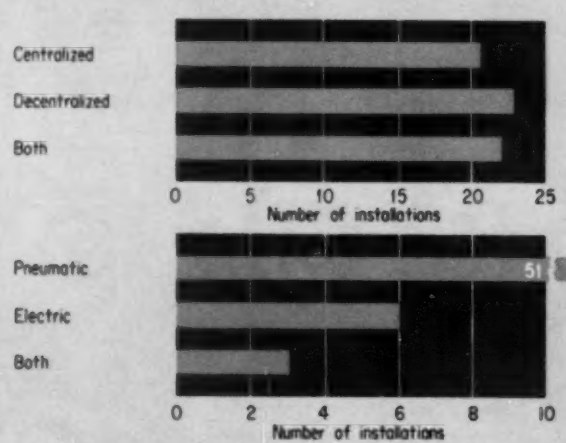
LOW-VELOCITY DUCTS handle most loads with single-rectangular-duct systems. Trend indicates simplicity of most conditioning designs

INSULATION — VAPOR SEAL



ALUMINUM FOIL wins top place as vapor seal, also appears with mastic in most combinations. Glass-fiber blanket shows a big gain

CONTROLS: LOCATION — TYPE



PNEUMATIC CONTROL handles majority of systems, but combined units show amazing growth. It's a tossup on local vs central control

1960 survey of commercial, industrial

Each listing covers 3 pages. Project number helps you track a specific installation after you turn facing page

Project Number	Company	Location	Consulting Engineer	Contractor	New or existing plant	Date of initial operation	SYSTEM: Total cooling load, tons	SYSTEM: Conditioned space, area, 1000 sq ft	SYSTEM: System type	SYSTEM: Manufacturer	SYSTEM: Installed in
1	Capitol Power Plant	Washington, D C	Guy B Panero		Ex	-----	7500	2000	Cen	YO	OB
2	Texas Instruments Inc	Dallas, Texas	Thermotank, Inc		New	-----	6300	-----	Cen	CC,TR	IP
3	Cobo Hall, Convention Area	Detroit, Mich	Giffels & Bossetti		New	-----	5300	1400	Cen	YO	Ins
4	Eastman Kodak Co, A & O Div	Rochester, N Y	Self		Ex	9-61	4500	400	Cen	TR,CC	IP,OB
5	Eastman Kodak Co	Rochester, N Y	Self		Ex	5-61	2750	-----	Cen,Con	WO	IP
6	L A International Airport	Los Angeles, Calif	J S Hamel	Scott Co of Southern Calif	New	-----	3000	-----	Cen	YO	Ins
6A	U S Post Office	Philadelphia, Pa	Kuljian Corp	Ambrose-Augusterfer	Ex	8-60	3000	1000	Cen	YO	PO
7	Penn A C Building	Philadelphia, Pa	Cronheim & Weger		Ex	9-60	1400	420	Con	CC	-----
8	Federal Office Building	Little Rock, Ark	Leo L Landauer & Assoc	Brown-Olds Plbg & Htg Corp	New	8-61	1100	361.6	Cen,Con	CC	OB
9	River House Apartment No. 2	Arlington, Va	General Engrg Assoc	Wm H Singleton Co, Inc	New	-----	1100	-----	Com	CC	Apt
10	Armstrong Cork Co	Lancaster, Pa	Charles S Leopold, Inc	B & G Olsen Co	Ex	4-60	1000	220	Con	CC	OB
11	Armstrong Cork Co, R & D Center	Lancaster, Pa	Charles S Leopold, Inc	Riggs-Distler Co	Ex	1959	850	155	Con	WO	OB
12	Fibre Industries	Shelby, N C	H K Ferguson Co		New	-----	1000	-----	Plag,Con,Ab	YO	IP
13	St Louis State Hospital	St Louis, Mo	Toensfeldt & Horch		New	-----	970	-----	Ab	CC	Hosp
14	Crown Zellerbach Corp	San Francisco, Calif	Skidmore Owings Merrill[16]		New	12-59	950	260	-----	CC	OB
15	Black & Decker Mfg Co	Towson, Md	Austin Co		New	7-60	776	180	Cen,CO	WO	IP
16	Boeing Airplane Co	Renton, Wash	Austin Assoc		Ex	6-59	735	230	Cen	AS	OB
17	Riddell Building	Washington, D C	General Engrg Assoc	Wm H Singleton Co, Inc	New	7-60	730	220	Cen,Com	YO	OB
18	Charles E Smith Building	Washington, D C	General Engrg Assoc		New	8-60	700	-----	Con	YO	OB
19	Sibley, Lindsay & Curr Co	Rochester, N Y	-----	A I McFarlan Co Inc	Ex	1960	669[2]	317	Cen,HP	CC	Dpt
20	Sears N Side Shopping Center	Miami, Fla	R L Duffer & Assoc	Hill York Sales Corp	New	2-60	644	180	Cen	YO	Dpt
21	Indiana State Teacher's College	Terre Haute, Ind	Ralph A Stuart		New	9-60	620	900	Cen,Ab	CC	Ins
22	Methodist Hospital	Dallas, Texas	-----		-----	-----	600	180	Con	TR	Hosp
23	State Agency Bldg	Miami, Fla	Walter Butler Co		New	-----	575	145	Con	YO	OB
24	U S Courthouse & Federal Office Bldg	Minneapolis, Minn	Frey & Bergston		New	1-61	564	146	Cen	CC	OB
25	John Hancock Ins Co	San Francisco, Calif	Skidmore Owings & Merrill		New	-----	542	155	Cen	CC	OB
26	Spohn Hospital	Corpus Christi, Texas	Vernor & Collins	Corpus Christi Plumbing	Ex	1-61	520	-----	Plag,Cen,CO	YO	Hosp
27	Bendix Aviation Corp	Holmdel, N J	-----		New	7-60	500	60	Plag,Cen	WO	IP
28	Ohio National Life Ins Co	Cincinnati, Ohio	Ziel-Blossom & Assoc		New	9-60	500	120	Cen,Com	TR	OB
29	Montgomery Ward & Co	Tampa, Fla	Austin Co		New	3-60	490	86	Cen,Com	TR	Dpt
30	Montgomery Ward & Co	Austin, Texas	Sumner Schein		New	3-60	300	125	Cen,Com	YO	Dpt
31	Montgomery Ward & Co	National City, Calif	Austin Co		New	3-60	268	-----	Cen,Com	CC	Dpt
32	U C L A Graduate Schl of Bus Admn	Los Angeles, Calif	J S Hamel		New	-----	445	170	Cen,Ab	CC	OB
33	Wayne State U, College of Education	Detroit, Mich	Ammann & Whitney	Lorne Plumbing & Heating Co	New	-----	431	-----	Cen,Ab	CC	Ins
34	Mt States Telephone & Telegraph Co	Phoenix, Ariz	R W Lockerbye		New	-----	408	-----	-----	YO	-----
35	Chattanooga State Hospital	Chattanooga, Tenn	Campbell & Jones		New	1-61	400	-----	Con	CC	Hosp
36	Oak Hall Apartment Building	Kansas City, Mo	Massaglia & Associates		New	6-61	400	180	Ab	CC	Apt
37	General Electric Co	Syracuse, N Y	Self		Ex	-----	385	60	Con	YO	IP
38	Television City	Hollywood, Calif	-----		Ex	1960	350[15]	150	Con	YO	OB
39	Central Bank & Trust Co	Denver, Colo	M S Wilson & Assoc		New	-----	335	-----	Plag,Cen,Com	CC,WE	OB
40	Fox Theatre	Detroit, Mich	-----	Arctic Air, Inc	Ex	-----	300	----[19]	Cen,Ab	YO	Th
41	Macy's Department Store	Kansas City, Mo	-----	Dan Truog & Clyde Nichols, Inc	New	-----	300	78	Cen,Com	CC	Dpt
42	Michigan Bell Telephone Co	Detroit, Mich	Smith, Hinchman & Grylls, Inc		Ex	1960	300	-----	Cen	YO	OB
43	Park Dale Mills	Gastonia, N C	-----		Ex	7-60	300	-----	-----	YO	IP
44	Regency Building Co	Kansas City, Mo	-----	Dan Truog & Clyde Nichols, Inc	New	-----	300	160	Cen,Ab	CC	Apt
45	Tri-County Hospital	Ft Oglethorpe, Ga	Lazenby & Borum	Air Comfort, Inc	Add	6-60	300	-----	Cen,HP,Com	YO	Hosp
46	Boeing Airplane Co	Seattle, Wash	Austin Assoc		-----	6-60	290	48.4	Plag,Cen	CC	Lab
47	Boeing Airplane Co	Seattle, Wash	Austin Assoc		-----	6-60	200	20	Plag,Cen	WE[13]	IP
48	Decatur Herald & Review	Decatur, Ill	S J Shure		Ex	5-60	262	36.8	Plag	YO	IP,OB
49	Fafnir Bearing Co	Newington, Conn	Austin Co		New	-----	250	55	Cen	TR	IP
50	Parish Press	New York, N Y	-----	Kalmanard Corp	New	5-60	245	25	Ab	YO	IP
51	Hercules Powder Co	Piste, W Va	-----		Ex	6-60	235	-----	Plag,Cen	----[8]	IP
52	Hartford Insurance Co Group	Cincinnati, Ohio	Ziel-Blossom & Assoc		New	12-60	220	70	Plag,Com	GA	OB
53	Toledo Home Federal Savings & Loan	Toledo, Ohio	Wm F Cann	Lumm Corp	New	1961	220	54.5	Cen	YO	OB
54	Blair Mills	Belton, S C	-----		Ex	5-60	210	29.4	CO	YO	IP
55	Calif Teachers Ass'n	Burlingame, Calif	Dudley Deane & Assoc	Gilmore Air Conditioning	New	1959	210	39.5	Con	TR	Ins
56	14th & 9th Ave Apt - Wedgewood House	New York, N Y	E U Markush		New	8-60	210	-----	Ab	CC	Apt
57	Childrens Hospital	Cincinnati, Ohio	Ziel-Blossom & Assoc		Ex	-----	205	-----	Cen,Com	YO	Hosp
58	Dallas Power & Light Co	Dallas, Texas	-----	Dallas Air Conditioning Co, Inc	Ex	-----	205	-----	Cen,CO,Com	YO	OB
59	First National Bank Bldg	Phoenix, Ariz	Lowry & Sorenson		Add	-----	200	-----	Con	YO	OB
60	Goldwaters Department Store	Phoenix, Ariz	Lowry & Sorenson		New	-----	200	-----	-----	YO	Dpt
61	Sun Shipbuilding & Dry Dock Co	Chester, Pa	-----		New	6-60	200	45	Con	YO	OB
62	Yakima Valley School	Selah, Wash	Valentine & Fisher	Central Heating & Plumbing Co	Ex	8-60	200	-----	Con	YO	Ins
63	Barden Corp	Danbury, Conn	A D Walker & Co, Inc		Ex	-----	175	30.5	Cen,Com	AS	IP,OB
64	El Paso Medical Bldg	El Paso, Texas	J C Freeman		New	-----	170	60	Cen,Ab	YO	Ins
65	International Business Mach Corp	St Louis, Mo	Bell & Given		New	8-60	170[14]	42	Cen,CO,Com	YO	OB
66	Inwer Grove Baptist Church	St Louis, Mo	Fitch & Nicholas	Shure-Richardson, Inc	New	1960	155	-----	Cen	YO	Ins
67	Upjohn Co	Kalamazoo, Mich	Austin Co		New	-----	150	15	Con	-----	IP
68	Wilshire Professional Bldg	Los Angeles, Calif	J L Hengstler		Ex	-----	150	37.2	Cen	YO	OB

Ab - Absorption
Add - Addition
Air - Air cooled
Apt - Apartment
As - Asbestos
B - Blank
Cc - Circular centrifugal
Ce - Centrifugal
Cen - Central
CO - Cooling only
Com - Compression
CSA - Chemicals self administered
CW - Chilled water
DC - Dust collector
DD - Dual duct
DER - Direct expansion refrigerant
Dpt - Department store
Er - Evaporator
Ex - Existing plant or equipment
Exp - Exposition center
Fl - Filter
G - Galvanized
HP - Heat pump
Hosp - Hospital
HV - High velocity
Ins - Institution
IP - Industrial plant
Lab - Laboratory
LV - Low velocity
M - Motor
Me - Metal
Mu - Multi-stage
N - None
OB - Office building
Pkg - Package
Pl - Plastic
PO - Post office
Pr - Precipitator
R - Refrigerant
Redw - Redwood
Rec - Rectangular duct
Rp - Reciprocating
S - Stage
SC - Service contract
SD - Single duct
SS - Single stage
St - Steel
T - Turbine drive
Th - Theater
Tr - Transite
Var - Various, varies
Wa - Washer
WC - Water cooled
WF - Wood fiber
Well - Well water
Zn - Zinc

1 - 2 at 1250 hp, 2 at 2500 hp
2 - Ultimate 1325 tons
3 - Zinc-chromalized aluminum paint
4 - Primary system supplies air to controllers; 800 chilled-tot water fan-coil units
5 - Dry bulb
6 - Each
7 - Plastic fortified cellulose
8 - Compressors by Carrier Corp and Frick Co; condensers by Halstead & Mitchell, and Trane Co
9 - Evaporating condenser
10 - Natural gas engine
11 - R-11, R-12, and R-22
12 - Washer, filter, dust collector, and precipitator

and institutional air conditioning

REFRIGERATION EQUIPMENT											COOLING TOWERS								AIR CLEANERS				
No. new units	Compressor type	Rpm	Refrigerant	Compressor drive	Drive hp	Drive manufacturer	H2O to coils, F	H2O from coils, F	Cooling medium	Condenser type	No. of towers	Manufacturer	Capacity, gpm	Cooling range, F	Wet bulb temp, F	Fill	Coating	Cooling water treatment	No. of cleaners	Manufacturer	Type	Ductwork type	Insert Note
4	Ce,Mu	4870	R-12	M	---- [1]	EM	40	46	CW	WC	4	MC	6600 [6]	95-85	95 [5]	Rdw	----	----	---	----------	----------	---------- [1]	
6	Ce	3440	---------- [11]	M,T	5592	EL	38	53	CW	WC	2	MC, P	18,900	95-85	75	Rdw	----	CSA	4	AAF	Fi	LV, SD [20]	2
4	Ce	5450	R-12	M	1250	IE	42	54	CW	WC	N	----------	----------	----------	----------	----------	----------	----------	40	WE	Fi, DC, Pr	---------- [17]	3
3	Ce	3600	R-11	M	1500 [6]	TR,CC	45	55	CW	WC	2	MC	9000 [6]	95-85	95 [5]	Rdw	Tr	CSA	14	FA,CFC	Fi	---------- [17]	4
1	Ce,Mu	4200	R-12	T	3000	WO	40	52	CW	WC	Ex	MC, P	25,000	...-85	78	Rdw	----	CSA	---	----------	----------	----------	5
3	2 Ce,1 Ab	-----	R-12	M	1500	AC	44	52	CW	WC	1	MC	10,560	95-85	72	Rdw	----	----	---	----------	----------	Rec, LV	6
2	Ce	-----	R-12	M	1500	ME	42	52	CW	WC	1	FP	9000	95-85	78	----	----	CSA	25	FA	Fi	SD, DD	6A
2	Ce	-----	----------	M	----	----	42	54	CW	----------	1	FP	4200	95-85	78	Pl	----	----	7	FA	Fi	SD [20,21]	7
2	Ce	3550	R-11	M	550	IE	42	54	CW	WC	1	WCE	3300	95-85	79	Rdw	----	----	2	FA	Fi	---------- [17]	8
2	Ce	3550	----------	M	----	----	45	51	DER	WC	1	FP	3300	95-85	78	Pl	----	----	---	----------	----------	Rec, LV, SD	9
2	Ce	3600	R-11	M	500 [6]	----	43	53	CW	WC	2	MC	1500 [6]	95-85	78	Rdw	----	CSA	---	AAF, CFC	Fi	Rec, LV, SD	10
2	Ce	3600	R-11	M	400 [6]	----	43	53	----------	----------	2	MC	2550 [18]	95-85	78	Rdw	----	CSA	---	AAF, CFC	Fi	Rec, LV, SD	11
---	----------	----	----------	----	----	----	47	57	CW	WC	1	----------	10,000	95-85	75	Rdw	----	CSA	4	BF	Wa	----------	12
2	----------	----	----------	----	----	----	----	45	CW	----------	1	LH	3500	102-85	78	Rdw	----	----	---	----------	----------	LV	13
3	Ce	----	----------	M	----	----	40	50	CW	WC	3	MC	7000	90-80	60	Rdw	----	CSA	15	AAF	Fi	Cc, HV, SD	14
1	Ce,SS	4500	R-12	---- [10]	915	WM	46	56	CW	WC	1	LH	2428	97-85	78	Rdw	----	----	17	TR	Fi	Rec, LV	15
1	Ce,2S	3600	R-11	M	----	LA	45	57	CW	WC	1	MC	2100	85-75	----	Rdw	----	CSA	15	AAF, CFC	Fi	Rec	16
2	Ce,SS	3600	R-114	M	350	YO	42	52	CW	WC	2	BAC	2200	95-85	78	St,G	G	SC	---	FA	Fi	Cc	17
2	Ce	----	R-11	M	350	----	45	53	CW	WC	2	BAC	1050	95-85	78	----	----	SC	3	AAF	Fi	---------- [20,21]	18
2	Ce	3550	R-113	M	305	GE	48	72	CW	WC	2	MC	4000	95-85	75	Rdw	----	CSA	---	BF	Fi	Rec, LV, SD	19
2	Ce	----	R-11	M	----	----	44	54	CW	WC	1	BY	2060	95-85	80	Rdw	----	----	---	FA	Fi	Rec, LV, SD	20
---	----------	----	----------	----	----	----	42	56	CW	WC	5	MC	1225	100-85	78	Rdw	----	CSA	6	AAF	Fi	LV [20,22]	21
2	Ce	3600	R-11	M	300	RM	42	50	CW	WC	2	FP	1875	95-85	78	Rdw	----	CSA	1	AAF	Fi, Pr	Rec, LV, HV	22
1	Ce	6400	R-114	M	500	LA	45	53	CW	WC	Well	----------	----------	----------	----------	----------	----------	----------	---	GA	Fi	Rec, LV, SD	23
1	Ce	----	R-11	M	550	CC	42	50	CW	WC	1	MC	1640	95-85	75	Rdw	----	----	8	AAF	Pr, Fi	---------- [21,22]	24
2	Ce	3550	R-113	M	265	----	40	49	----------	WC	2	----------	700	90-78	----	Rdw	----	CSA	5	FA	Fi	HV [20,22]	25
2	Ce	----	R-11	M	260	----	44	52	CW	WC	1	MC	2000	94-86	95 [5]	Rdw	----	CSA	6	EA	DC, Pr, Fi	---------- [17]	26
2	Ce	1750	----------	M,T	25	WO	42	52	CW, DER	Air	2	MC	2029 [18]	95-85	78	Rdw	----	CSA	13	WE	---------- [12]	Rec, LV [22]	27
2	Ce	----	R-11	M	250	----	45	55	CW	WC	2	BAC	1050	95-85	78	St,G	G,--- [3]	CSA	5	EA	Fi, Pr	---------- [17]	28
1	Ce	3600	----------	M	----	----	46	58	CW	WC	1	BY	1500	95-85	79	Rdw	----	----	9	----------	Fi	Rec, LV, SD	29
1	Ce,SS	7500	R-11	M	300	BW	46	56	CW	WC	1	MC	900	95-85	78	Rdw	----	----	N	----------	----------	Rec, LV	30
1	Ce	3850	R-113	M	----	----	42	52	CW	WC	1	MC	795	95-85	70	Rdw	----	SC	6	----------	Fi	Rec, LV, SD	31
---	----------	----	----------	----	----	----	40	48	CW	WC	1	MC	1795	99-83	68	Rdw	----	CSA	---	BU	Fi	Rec, LV, DD	32
1	----------	----	----------	----	----	----	45	----	CW	----------	2	BAC	780	102-85	75	St,G	---- [3]	CSA	2	MCC	Wa	---------- [17]	33
1	Ce	----	R-114	M	400	YO	45	53	CW	WC	1	MC	1200	95-85	78	Rdw	----	SC	2	FA	----------	Rec, LV, SD	34
1	Ce	3600	R-113	----	----	----	45	55	CW	WC	1	MC	----------	95-85	78	Rdw	----	----	---	----------	----------	Rec	35
1	----------	----	----------	----	----	----	45	55	CW	WC	1	P	1200	103-85	76	Rdw	----	CSA	170	JMC	Fi	Rec, LV	36
1	Ce	7000	R-11	M	370	YO	50	60	CW	WC	1	MC	1200	95-85	75	Rdw	----	CSA	---	FA	Fi	Rec, LV, SD	37
1	Ce,SS	7000	R-11	M	300	WE	45	55	CW	WC	1	MC	4160	91-81	70	Fir	----	CSA	---	BU	Fi	Rec, LV	38
37	Rp,SS	1750	R-12,R-22	----	350	----	45	52	CW, DER	WC	4	HC, MC	----------	90-80	65	Rdw	----	CSA	150	GY	Fi	Rec, Cc, LV	39
1	----------	----	----------	----	----	----	42	50	CW	----------	3	HC	1042	103-85	75	Rdw	G	CSA	---	----------	----------	----------	40
1	Ce	3500	R-113	M	305	----	45	55	CW	WC	1	MC	900	95-85	78	Fir	----	CSA	38	AAF	Fi	Rec, LV, SD	41
2	Ce	----	----------	M	150 [6]	YO	45	55	CW	WC	1	MC	900	95-85	75	Rdw	G	CSA	----	----------	----------	Rec, LV, DD	42
1	SS	----	R-11	M	300	RM	45	55	CW	WC	1	P	900	95-85	95 [5]	Rdw	----	----	2	AAF, TRI	Wa, Fi, Pr	Rec, LV	43
4	----------	----	----------	----	----	----	45	55	CW	WC	1	CC	1080	103-85	78	Pl	----	----	18-480	----------	Fi	Rec, LV, SD	44
2	Rp	1170	R-22	M	150	AC	45	55	CW	Ev	---	----------	----------	----------	----------	----------	----------	----------	3	AAF, SCC	Wa, Fi	Rec. LV, SD	45
1	Ce	----	R-11	M	300	----	42	52	CW	WC	1	BAC	510	85-75	80	St	----	CSA	5	AAF	Fi	---------- [17]	46
1	Ce	----	R-11	M	200	----	42	52	CW	WC	1	MC	900	85-75	80	Rdw	----	CSA	---	CON	Fi	---------- [17]	47
1	Ce	----	R-11	----	----	---	---	---	CW	----------	---	LH	780	95-85	78	Rdw	----	CSA	---	----------	Fi	Rec, LV, HV	48
1	Ce	----	R-11	M	----	----	45	55	CW	WC	1	MC	750	95-85	95 [5]	Rdw	----	CSA	10	EA	Pr	Rec, LV, SD	49
1	----------	----	----------	----	----	----	45	53	CW	----------	2	BAC	480 [6]	105-85	95 [5]	St	G	SC	---	----------	----------	Rec, LV	50
14	Rp	1750	R-22	M	275	GE,WE	35	40	CW, DER	WC, Air	1 [9]	TR	85	95-85	95 [5]	Rdw	Zn	CSA	16	----------	Fi	Rec	51
5	Rp,SS	----	R-12	M	Var	----	---	---	DER	WC	1	MC	----------	----------	----------	Rdw	----	CSA	---	FA	Fi	Rec, LV [22]	52
1	Ce	----	R-11	M	200	YO	46	56	CW	WC	1	MC	660	95-85	75	Rdw	----	SC	3	TRI	Pr	---- [23] ---- [22]	53
1	Ce	----	----------	M	200	WE	46	56	CW	WC	1	FP	630	95-85	78	Pl	As	----	N	----------	----------	----------	54
1	Mu	1725	R-111	M	210	TR	48	58	CW	WC	1	MC	550	78-72	85	Rdw	----	SC	---	AAF	DC	Rec, LV	55
1	----------	----	----------	----	----	----	44	53	CW	WC	1	CC	780	105-87	78	---- [7]	Zn	SC	---	----------	Fi	----------	56
1	Ce	----	R-11	M	200	----	45	55	CW	WC	1	BAC	990	95-85	78	St	G	CSA	18	AAF	Fi, Pr	---------- [17]	57
1	Ce,SS	9600	R-11	M	200	WE	45	55	CW	WC	Ex	----------	----------	----------	----------	----------	----------	----------	---	----------	----------	Ex	58
1	Ce	----	----------	M	200	YO	45	52	CW	WC	1	FP	600	95-85	110 [5]	Pl	----	CSA	48	FA	Fi	----------	59
1	Ce	----	R-11	M	200	YO	45	53	CW	WC	1	MC	----------	95-85	78	Rdw	----	SC	2	EA	Fi	Rec, LV, SD	60
1	Ce	3600	R-11	M	200	LA	45	55	CW	WC	2	MC	600	95-85	95 [5]	Rdw	----	CSA	---	----------	Fi	Rec, LV, SD	61
1	Ce	----	R-11	M	250	BW	42	52	CW	WC	1	P	630	90-80	65	Rdw	----	----	1	MH	Pr	Rec, LV	62
1	Ce	3550	R-113	M	----	LA	42	52	CW	WC	1	MC	525	95-85	95 [5]	Rdw	----	CSA	2	WE	Pr	Rec, LV	63
1	----------	----	----------	----	----	----	45	55	CW	----------	1	FP	840	102-85	69	Rdw	----	----	38	FA	----------	LV, DD	64
1	Ce,Mu	1700	R-12	M	200	----	42	50	CW	WC	1	MC	640	95-85	78	Rdw	----	----	1	AAF	Fi, Pr	---------- [17]	65
1	Rp	1750	R-22	M	75	LA	44	54	CW	WC	1	LH	465	95-85	78	Rdw	----	----	60	FA	Fi	Rec, LV, SD	66
N	----------	----	----------	----	----	----	54	66	Well	----------	N	----------	----------	----------	----------	----------	----------	----------	5	AAF	Fi	Rec, LV, SD	67
1	Ce	3600	R-11	M	150	----	44	56	CW	WC	1	MC	450	93-83	72	Rdw	Me	SC	90	BU	Fi	Rec, HV, DD	68

13 - Air units, York compressor and condenser
14 - Ultimate 214 tons
15 - Addition, total 1605 tons
16 - And Hertzka & Knowles
17 - Rectangular, circular conduit, low velocity, high velocity, single duct, dual duct
18 - Total
19 - 5000 seat theater
20 - Rectangular, circular conduit
21 - Low velocity, high velocity
22 - Single duct, dual duct

MANUFACTURERS

AAF - American Air Filter Co Inc
AC - Allis-Chalmers Mfg Co
ACC - American Coolair Corp
AE - Acme Engrg & Mfg Corp
AR - Armstrong Cork Co
AS - American Standard, Ind Div
BAC - Baltimore Aircoil Co, Inc
BC - Barber Coleman Co, Controls Div
BF - Buffalo Forge Co
BH - Bacharach Ind Co
BI - Binks Mfg Co
BU - Burke & Co
BW - Berry-Warner Corp
BY - Belcher-Young Inc
CC - Carrier Corp
CE - Century Electric Co
CF - Clarage Fan Co
CFC - Cambridge Filter Corp
CHB - Chicago Blower Corp
CIN - Cinder Engineering Co
CON - Continental Air Filters, Inc
DB - Dean & Benson Research, Inc
DE - Dryer Electric Corp
DH - Dreyer Hansen Div
EA - Electro-Air Cleaner Co, Inc
ED - Electro-Dynamic Div of General Dynamics Corp
EKC - E K Campbell Co
EL - Elliott Co
EM - Electric Machinery Mfg Co
FA - Farr Co
FG - Fibre Glass Div, Ferro Corp
FM - Fairbanks, Morse & Co
FP - Fluor Products Co
GA - Governair Corp
GB - Gustin-Bacon Mfg Co
GE - General Electric Co
GY - Goodyear Tire & Rubber Co, Inc
HC - Havens Cooling Towers Div
HM - Hamstead & Mitchell
HY - Hill York Sales Corp
IE - Ideal Electric & Mfg Co
JM - Johns-Manville
JMC - Johnson-Marvin Corp
JO - Joy Mfg Co
JS - Johnson Service Co
K - The Kiefaud Co, Inc
LA - The Louis Allis Co
LH - Lilie-Hoffman Cooling Towers, Inc
MC - The Marley Co
MCC - Marlo Coil Co
MCQ - McQuay, Inc
ME - Marathon Electric Mfg Co
MH - Minneapolis-Honeywell Regulator Co
MU - Mundet Cork Corp, Insulation Div
NYB - New York Blower Co

1960 air-conditioning survey continued

Compiled by: Lawson Stewart, Associate Editor and Althea Thornton

Project number	AIR HANDLING EQUIPMENT: SUPPLY FANS: Number	Capacity 1000 cfm	Rpm	Manufacturer	Drive hp	Drive rpm	Drive manufacturer	RETURN FANS: Number	Capacity 1000 cfm	Rpm	Manufacturer	Total drive hp	Drive rpm	Drive manufacturer	INSULATION: Type	Manufacturer	Vapor seal	CONTROLS: Manufacturer	Type	Location	VIBRATION MOUNTS: Manufacturer	Type	Sound absorbent
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	310	1800	2000	TT, TR, BF	Var	Var	.....	N	.....	.....	.....	.....	.....	.....	Fg	AR	Doj	JS, PR, MH	Tp, H, Pn	NG, CS	.....	Sp, Rls, Ck	.....
3	50	130-1.5	.....	WE	Var	1750	WE	40	230-4	.....	WE	Var	1730	WE	.....	OC	23, Al	MH	.....	NG, CS	VE	Rls	ID
4	14	.....	Var	CF	.....	Var	GE, WE, LA	10	.....	.....	CF	.....	Var	GE, WE, LA	Fg, Ck	GR, JM, OC	Pre, Doj, Al	MH, PR	 24	NG, CS	K, VE	Sp, Rls	ID
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6A	26	1000	.....	AS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Fg	FG	.....	JS	Tp, Pn	.....	.....	.....	.....
7	.....	.....	Var	CC	Var	.....	.....	14	.....	.....	AS	.....	.....	.....	Fg	AR	.....	JS	Tp, H, Pn	.....	.....	.....	.....
8	2	60.1	1188	BF	87.8	1220	WO	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	JS	Tp, H, Pn	.....	.....	.....	.....
9	1460 25	Var	.....	WO, AS	.....	.....	.....	2	42.3	289	BF	6.9	253	.....	Bo, Bl	OC	Doj, Al, Imp	PR	Tp, Pn	NG, CS	VM	Sp, Rls, Ck	ID
10	19	320	Var	WE	300 18	1750	WE	9 26	.....	.....	AS	.....	.....	.....	Bl	.....	Doj, Al	MH	Tp, Pn	.....	.....	Sp	.....
								12	227 18	Var	WE	92 18	1750	WE	Fg, Ck	AR	...23, Imp, Pl	JS	Tp	.....	VE	Sp, Rls	ID
11	7	185	Var	SW	220	.....	.....	3	117	Var	SW	55	Var	.....	Fg, Ck	AR	...23, Imp, Pl	MH	Tp	.....	VM	.....	ID
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	10	Var	.....	MCC	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	Bo	MU	MC	JS	.....	.....	VE	Sp	.....
14	11	.....	.....	.....	.....	.....	.....	11	.....	.....	.....	.....	.....	.....	Bo, Bl	FG	.....	JS	Tp, H, Pn	CS	K	Sp, Rls, Ck	ID, IMR
15	17	1.2-20	.....	TR	0.75-15	1750	.....	.....	.....	.....	.....	.....	.....	.....	Bl	OC	VP	JS	Tp, Pn	NG	.....	Ck	.....
16	15	14-20	732	AS, TR	Var	1725	GE	12	14-20	.....	AS	Var	1725	GE	Bl	.....	.....	.....	Tp, H, Pn	CS	.....	Solid	.....
17	2	140	Var	BF	Var	1750	GE	2	120	600	BF	19 6	1750	.....	Bo, Bl	FG	Doj, Al, Imp	PR	Tp, Pn	NG, CS	VE	Sp, Rls, Ck	ID, IMR
18	3	113.3 18	.....	CF	60, 30	1750	.....	2	46	.....	ACC	15	1750	GE	.....	PCM	.....	JS	Tp, H, Pn	CS	K	Sp, Rls	ID
19	11	191.8	.....	BF	115 18	.....	.....	N	.....	.....	.....	.....	.....	.....	Bl	Rl	.....	JS	Tp, H, Pn	.....	.....	Rls	.....
20	21	.....	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	Pre, Al	JS	Tp, Pn	.....	HY	Sp	.....
21	6	25	750	CHB	15	1730	FM	6 26	12	750	CHB	5	1730	.....	Bo, Bl	PCM	Pre, Al	JS	Tp, H, Pn	NG, CS	K	Sp, Rls	ID
22	24	168	1720	TR	Var	.....	CE	.....	.....	.....	.....	.....	.....	.....	Fg	.....	Doj, MC, Al	PR	.....	.....	.....	Sp	ID
23	11	16 29	Var	GA	10 29	1800	.....	.....	.....	.....	.....	.....	.....	.....	Bo	BM	Pre	MH	Pn	NG	.....	Sp	.....
24	6	.....	.....	CC	.....	.....	AS	.....	.....	.....	.....	.....	.....	.....	Bo, Bl	JM	Doj	JS	Tp, H, Pn	.....	VM	Sp	ID
25	6	.....	.....	TR	.....	.....	SEM	4	.....	.....	.....	.....	.....	.....	Bo, Bl	.....	.....	JS	Tp, H, Pn	.....	.....	.....	ID
26	13	119	Var	THE	182	1750	.....	18 26	.....	.....	.....	.....	.....	.....	Bl	.....	.....	JS	Tp, H, Pn	.....	.....	.....	ID
27	13	164	900	WE	132	.....	.....	.....	.....	.....	.....	.....	.....	.....	Bl	GR	Doj, MC ...30	PR	 24	NG, CS	.....	Sp, Rls, Ck	ID, IMR
28	2	167	855	DB	150	.....	AS	1	189.5	720	DB	100	.....	.....	Bl	JM	Doj, MC, VP	PR	Tp, H, Pn	NG	.....	Rls	.....
		97	1070		100										Bo, Bl	AR	Pre, Imp	JS	Tp, Pn	NG, CS	VE	Sp, Rls	ID
29	9	92.5 18	.....	TR	.....	.....	.....	1 26	.....	.....	.....	.....	.....	.....	Fg	.....	.....	MH	Tp, Pn	.....	TR	Rls	.....
30	2	110 18	 27	SW	55 18	1750	.....	N	.....	.....	.....	.....	.....	.....	Fg	C1N	Doj	PR	Pn	.....	K	.....	.....
31	6	89.5 18	.....	WE	.....	.....	.....	6 26	.....	.....	.....	.....	.....	.....	FG	GB	.....	PR	Tp, Pn	NG, CS	.....	.....	.....
32	5	35 26	380 29	NYB	25	1750	.....	5	20 29	225 29	NYB	10	1750	.....	Fg	JM	.....	PR	Tp, Pn	.....	.....	Sp	ID
33	2	41	1300	SW	75	1300	.....	1	81	320	SW	20	320	.....	Bo, Bl	JM	VP	PR	Tp, H, Pn	CS	VM	Sp, Rls	.....
34	22	.....	.....	MCC	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	Bo, Bl	FG	.....	JS	Tp, H, Pn	NG	K	Sp	.....
35	17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Fg	OC	.....	JS	Pn	.....	.....	Sp	ID
36	160	1200	1000	McQ	0.5	.....	GE	N	.....	.....	.....	.....	.....	.....	Fg	GB	.....	JS	Tp, Pn	.....	K	Ck	ID
37	4	26 6	.....	YO	15	1750	GE	4	26 6	.....	YO	15	1750	GE	N	.....	.....	MH	Tp, H, Pn	.....	.....	.....	N
38	 28	Var	.....	DH	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Fg	GB	Pre	BC	Tp, E, El	NG	K	Ck	ID
39	44	.....	Var	CC, McQ	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Fg	.....	.....	MH	Tp, Pn, E	NG, CS	.....	Sp	.....
40	Ex	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41	10	.....	.....	CHB	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	DuL	GB	DuL	JS	Tp, Pn	NG, CS	.....	.....	ID
42	9	14	Var	WO	Var	Var	.....	N	.....	.....	.....	.....	.....	.....	Bo, Bl	AR	Pre, Al	MH	Tp, Pn	.....	VE	Rls	ID
43	1	28	1100	BF	15	1750	.....	.....	.....	.....	.....	.....	.....	.....	Foam	.....	.....	JS	Tp, H, Pn	CS	.....	.....	.....
44	31	36	.....	CHB	.....	.....	.....	28	13	.....	CHB	.....	.....	.....	DuL	GB	DuL	MH	Tp, H, E	NG, CS	.....	.....	ID
45	188	80	.....	YO, TR	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Foam	.....	.....	MH	Tp, H, Pn	NG	.....	.....	.....
46	5	85	.....	CC	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	Bl	.....	Al	PR	Tp, H, Pn	.....	.....	Rls	ID
47	4	54	.....	WE	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	Bl	.....	Al	MH	Tp, H, Pn	.....	.....	Sp	ID
48	 32	.....	.....	MCC, AAF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Bl	.....	Doj, MC, Imp	MH	.....	.....	.....	.....	ID
49	4	22	.....	TR	15	1750	.....	.....	.....	.....	.....	.....	.....	.....	Fg	.....	.....	JS	Tp, H, Pn	.....	.....	.....	.....
50	4	65 18	900 29	AE	Var	1800	ED	N	.....	.....	.....	.....	.....	.....	Bo, Bl	RK	MC, Al	JS	.....	.....	.....	Rls	ID
51	14	10	600	CC, HM	15	1750	GE, WE	N	.....	.....	.....	.....	.....	.....	Fg	FG	Doj, Al	JS, PR	Tp, H, Pn	CS	.....	Sp	.....
52	5	78.8	750	GA	Var	1750	.....	2	32 6	860	JO	10	1750	.....	Bo, Bl	AR	Pre, Imp	MH	Tp, Pn	NG	VE	Sp, Rls	ID
53	3	84.9 18	1750	TR, CC	Var	Var	TR, CC	5	82.1 18	1750	DE	Var	Var	DE	Bo, Bl	.....	Doj	.....	Pn	CS	K	Rls	ID
54	Ex	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
55	6	.....	.....	TR	15-30	.....	2	.....	.....	.....	.....	.....	.....	.....	Fg	JM	.....	BC	Tp, El	.....	TR	Rls	ID
56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
57	1	65.5	1350	JO	25	.....	.....	2	9.1	600	BF	2	.....	.....	Bo, Bl	AR	Pre, Doj, Al	JS	Tp, H, Pn	NG	VE	Sp, Rls	ID, FSA
58	Ex	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	3	.....	.....	AS	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	Bo, Bl	FG	.....	JS	Tp, H, Pn	NG	K	Sp	.....
61	4	68	1800	YO	Var	.....	WEC	N	.....	.....	.....	.....	.....	.....	Fg	.....	.....	BC	Tp, E	.....	K	Comp	N
62	1	64.6	1200	WB	40	.....	.....	1	42.8	148	WB	10	.....	.....	Fg, Ck	AR	Doj, MC, VP	JS	Tp, H, Pn	.....	YO	Sp	.....
63	4	41 18	Var	AS	Var	.....	.....	.....	.....	.....	.....	.....	.....	.....	Bl	JM	Doj, Al	JS	Tp, H, Pn	.....	.....	.....	.....
64	3	20	.....	YO	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	Bl	.....	Al	.....	Pn	.....	.....	Sp	ID
65	1	62	1000	AS	75	1750	.....	.....	.....	.....	.....	.....	.....	.....	Bl	GB	Al	PR	Tp, Pn	CS	K	Sp, Rls, Ck	ID
66	1	63.3	212	EKC	30	1750	AC	Fl	.....	.....	.....	.....	.....	.....	Fg	JM	Pre, VP	MH	Tp, E	NG, CS	K	Sp, Rls	ID
67	5	100	.....	CF	.....	.....	.....	2	20	.....	.....	.....	.....	.....	Fg	JM	Al	CF	.....	.....	K	Rls	.....
68	1	60	.....	CHB	50	.....	.....	N	.....	.....	.....	.....	.....	.....	Fg	.....	Doj	MH	Tp, Pn	.....	.....	.....	.....

OC - Owens-Corning Fiberglas Corp
P - J F Pritchard & Co
PCM - Philip Carey Mfg Co
PR - Powers Regulator Co
RI - Rochester Ind Insulation Inc
RK - Robert A Keasby Co, Inc
RM - Reliance Electric & Engrg Co
SCC - Surface Combustion Corp
SEM - Sterling Electric Motors, Inc
SW - Sturtevant Div, Westinghouse Electric Corp
THE - Thermal Engrg Corp
TR - Trane Co
TRI - Trion, Inc

TT - Thermotank, Inc
VE - Vibration Eliminator Co
VM - Vibration Mountings Inc
WB - Western Blower Co
WCE - Water Cooling Equipment Co
WE - Westinghouse Electric Corp
WEC - Wagner Electric Corp
WM - Waukesha Motor Co
WO - Worthington Corp
YO - York Div, Borg-Warner Corp

Al - Aluminum foil
Bl - Blanket
Bo - Board

Ck - Cork
Comp - Composition
CS - Central scanning
Doj - Done on the job
Duct - Duct liner
E - Electric
El - Electronic
Ex - Existing
Fg - Fiber glass
Foam - Foam glass
FSA - Fabricated sound absorbers
H - Humidity
ID - Inside duct
Imp - Impregnated paper

INR - Inside machinery room
MC - Mastic coating
N - None
NG - At or near grill
PF - Plastic
Pn - Pneumatic
Pre - Pressated
Rls - Rubber in shear
Sp - Springs
Tp - Temperature
Var - Various
VP - Vinyl plastic
23 - Pressated, done on job, mastic coating

24 - Temperature, humidity, pneumatic, electric, electronic
25 - Fan coil units, plus 7 miscellaneous units
26 - Exhaust fans
27 - One at 439 rpm, one at 494 rpm
28 - Air handling units
29 - Average
30 - Aluminum foil, impregnated paper
31 - Primary air
32 - 13 interior zone air handling units to serve ducts; 109 wall mounted exterior zone cabinet type room convectors

How to inspect electric welded tubing with ultrasonic sound waves

National Tube tests all USS National Electric-Resistance Welded Pressure Tubing with ultrasonic sound waves. As the tubing slides directly over a ground quartz crystal, electrical pulses are focused on the weld area. The crystal changes these pulses into ultrasonic vibrations which bounce off the the weld and reflect its strength or weakness. The vibrations are speared by the crystal, converted back into electrical energy, and floated across an oscilloscope screen.

If a bad weld is reflected, the electrical current dances wildly on the screen and triggers an alarm system. The crooked pattern is pen-recorded on a graph, a frog-voiced horn croaks loudly, and the tubing is squirted with black paint to mark the defect.

In case the ultrasonic unit breaks down, a red-faced dome light automatically flashes, revolves and winks at the weld inspector. This blushing signal tells him that the unit needs to be checked. It's added insurance that every length of pressure tubing is completely tested before it leaves the plant.

Our inspection techniques are rigid. But they help us develop a high quality product for use in applications such as boilers, heat exchangers, condensers, superheaters, economizers and other types of heat transfer equipment.

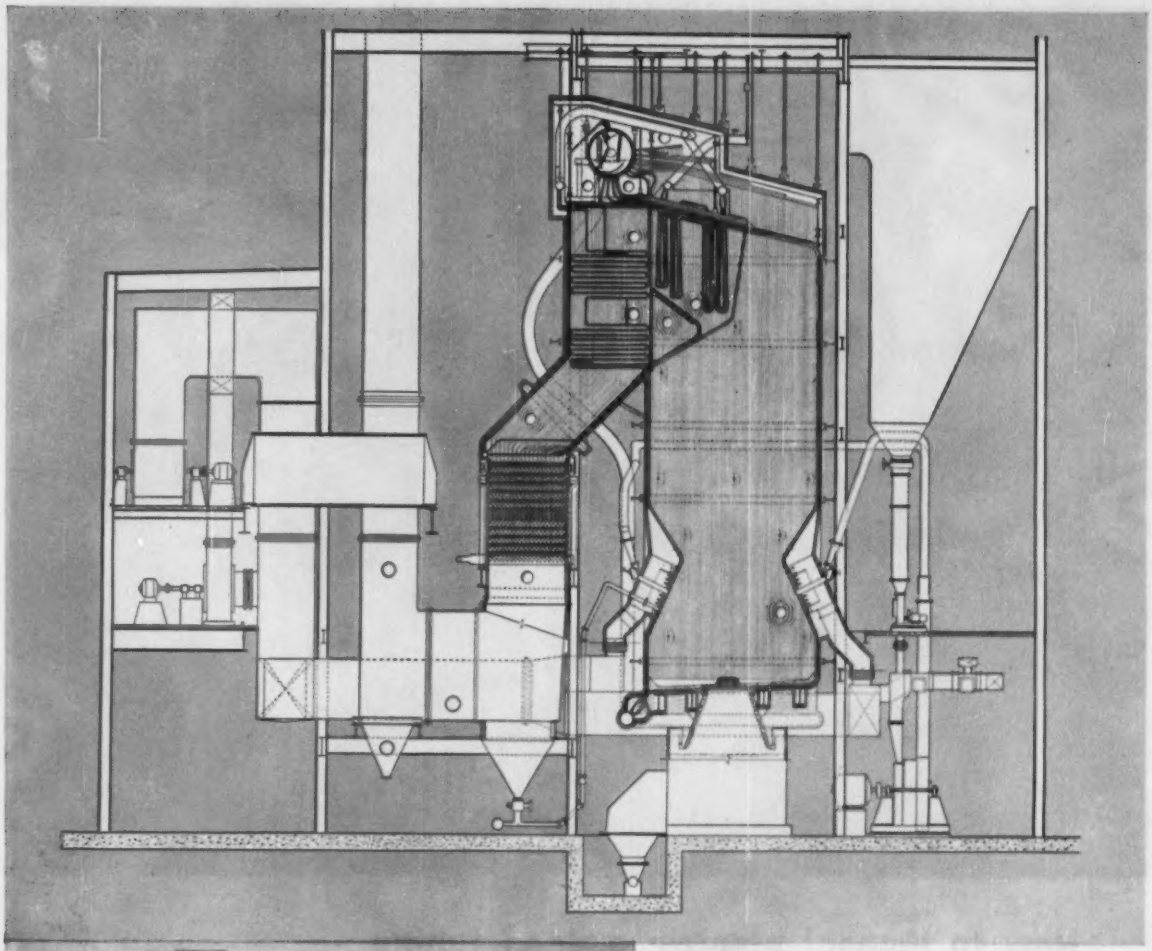
USS National Electric Welded Pressure Tubing is available in sizes ½" O.D. to 5½" O.D. inclusive, in walls from .035" to .250", and in lengths up to 44 feet. Consider USS National Electric Welded Tubing for your next installation. It's stocked by National Tube Distributors all over the country. Our trained Mill Service Force is also available for field consultation. Write National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

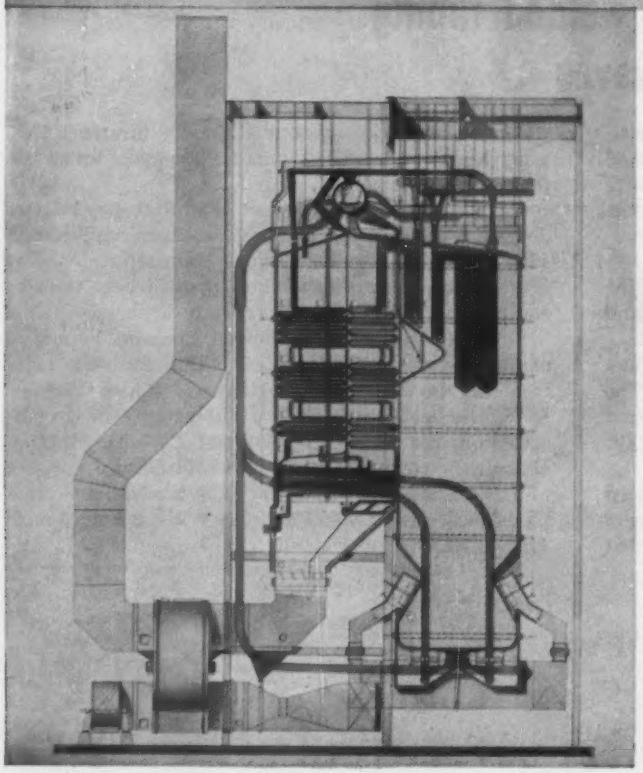
USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Supply Division
United States Steel Export Company, New York

This mark tells you a product is made of modern, dependable Steel.





A Progressive Chemical Company

One 400,000 lbs/hr Turbo Furnace Boiler: 830 F — 1250 psig. Unit is fired by pulverized coal from three Riley Pulverizers. A second Turbo Furnace Boiler of 600,000 lbs/hr has been purchased for a second plant at this location.

A Louisiana Public Utility

One 1,550,000 lbs/hr Turbo Furnace Boiler; 1005 F superheat, reheat — 2175 psig. This unit has a furnace 55 feet wide with no water cooled platens or dividing walls. Fired by natural gas. Can be converted to coal quickly and at low cost.

A Prominent Manufacturer of Electrical and Electronic Equipment

One 150,000 lbs/hr Boiler: 835 F — 900 psig; Fired by pulverized coal. One Duplex Riley Pulverizer.

For the full operating facts of Riley Turbo Furnace Boilers consult your Riley representative.

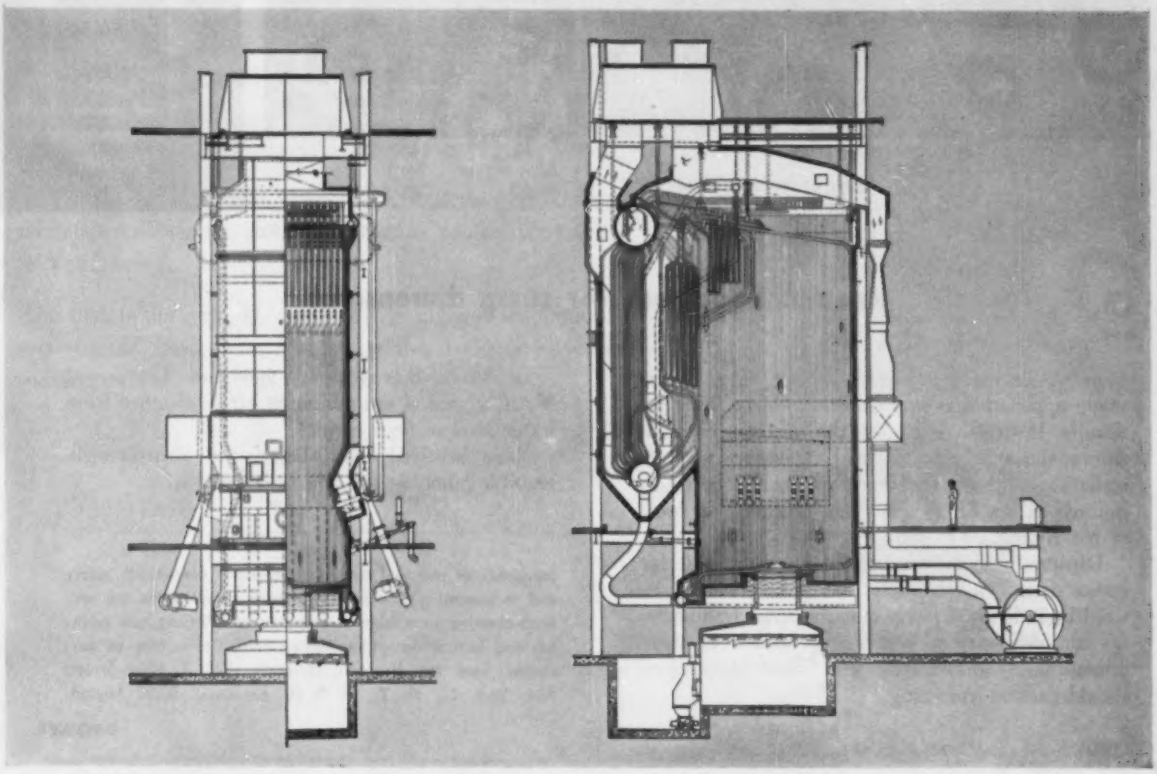
These Three Companies Selected The
RILEY TURBO FURNACE
Because Of These Outstanding Performance Characteristics

- Eliminates the flyash disposal problem
- Clean furnace walls eliminate necessity of wall deslagging equipment
- High operating efficiency — minimum carbon loss — low excess air
- Uniform distribution of furnace gases across full width of the superheater with minimum variation in metal skin temperatures from side to side
- Maximum utilization of waterwall surface
- Economical and quick conversion from gas and oil firing to coal
- Because of performance characteristics, the Riley Turbo Furnace can be operated at higher heat releases: The size of the unit is reduced thus reducing building costs and permitting higher capacity within a given space
- A wide furnace is possible without need for dividing walls
- One level firing reduces expense for walkway systems
- Provides ease of observation and operation

FOR TURBO FURNACE DETAILS — WRITE RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS

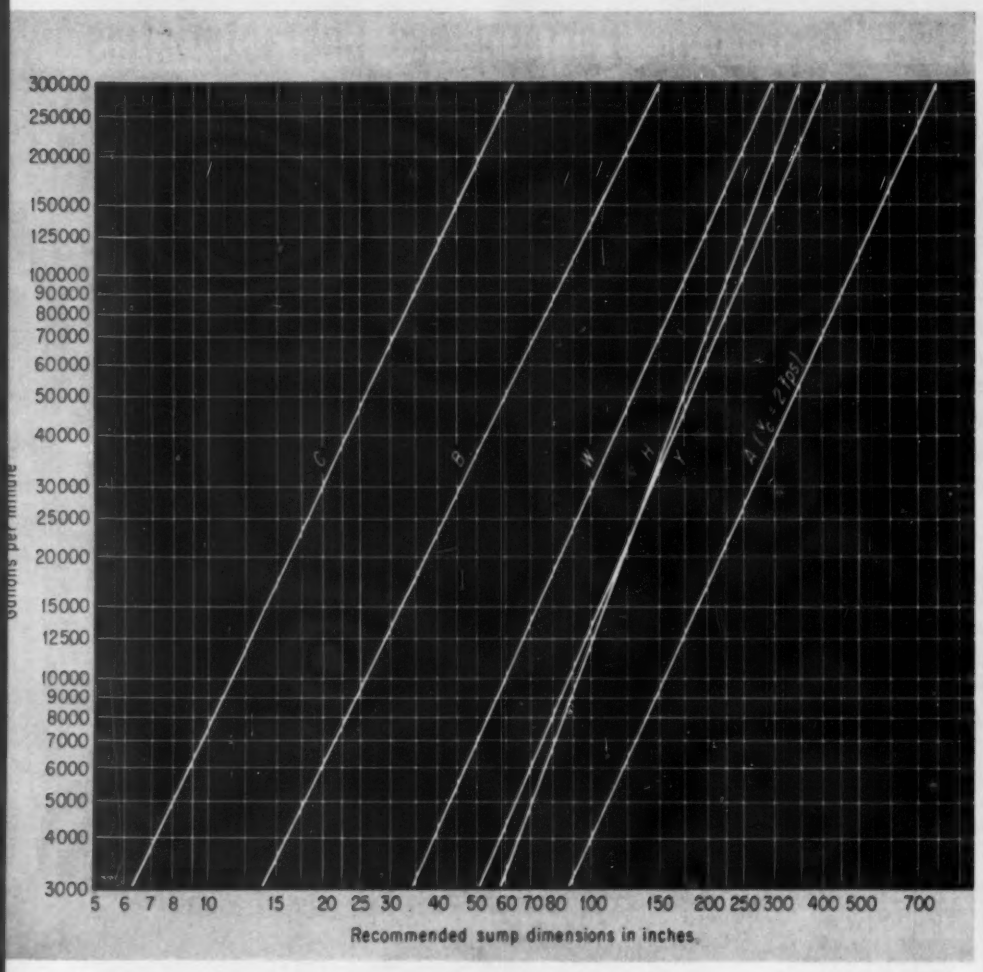
A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

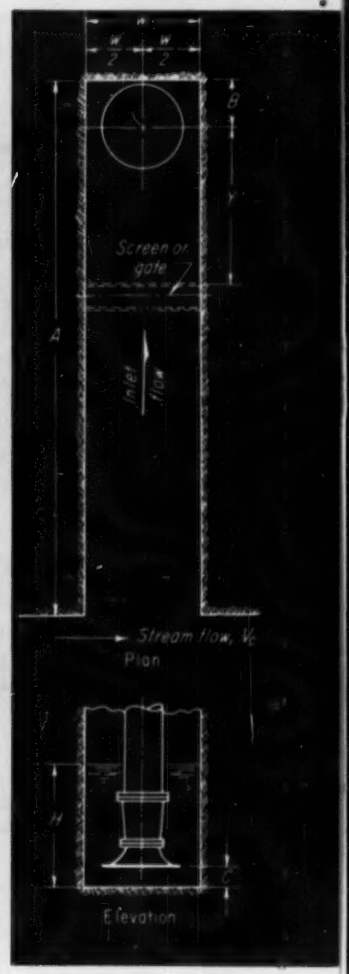
RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT



Power's data sheet

No. 338





Recommendations for sump dimensions

One of the more important aspects of successful pump application is *suction environment.* The Hydraulic Institute developed the recommendations shown above in years of field experience with installations and model research. Data will be incorporated as Fig. BF-13.1 in Tenth Edition, *Standards of the Hydraulic Institute.*

Dimensions shown are considered reliable for intake design, subject only to slight variations desired by individual pump manufacturer. Ordinarily it's not necessary to test model intakes of these dimensions. Conformance with chart dimensions should prevent vortexing.

Dimension *B* is suggested maximum, *C* average; *W*, *H*, *Y* and *A* are minimum (*H* is distance from water level to floor of pit).

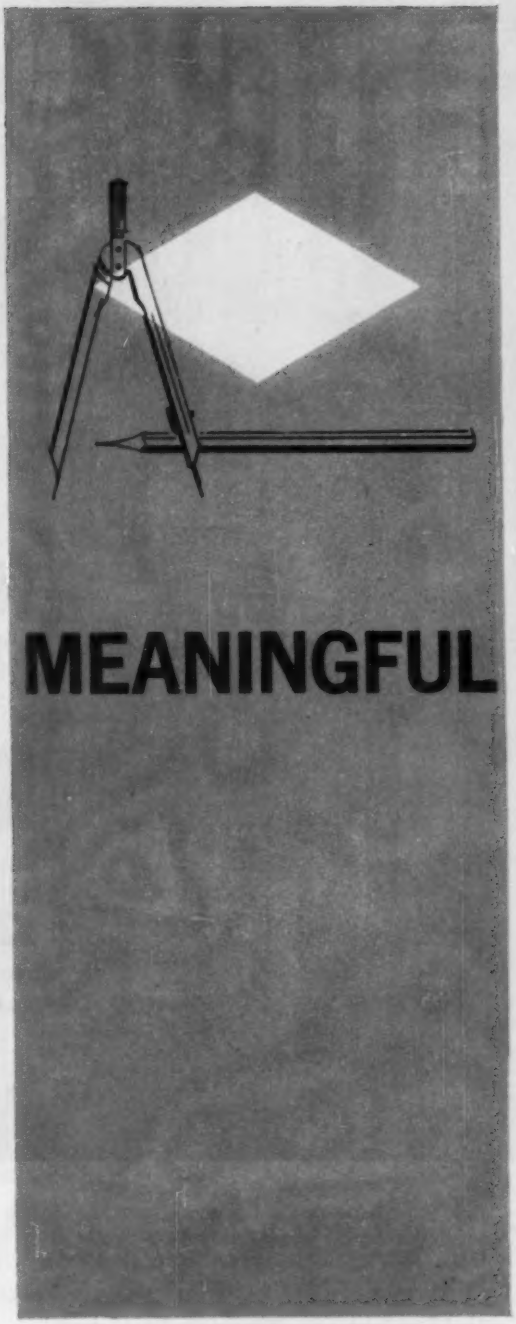
More involved inlet shapes and structures in multiple pumping pits will be covered later.

Standards of the Hydraulic Institute **cover centrifugal, rotary and reciprocating pumps. Within each classification are sections covering nomenclature, hydraulic calculations, test methods and installation and operating data. Copies may be purchased from the Hydraulic Institute, 122 E 42nd Street, New York 17, N. Y., at $6.00 per copy, $6.50 foreign.**

© POWER

HOW TO DESIGN A TRADEMARK

Why, it's easy as A-B-C. Just start with a simple shape, one that's readily identified and easily remembered. (The Jenkins Diamond is a good example.) Then just fill in the blank spaces. That's all there is to it, and almost anyone can do it!



HOW TO MAKE IT MEANINGFUL

Ah, that isn't so easy nor so simple.

A trademark is like a man's signature: it can mean much or it can mean little.

Time and *performance* make the difference.

Take the Jenkins Bros. trademark. There's nothing tricky about the design, certainly nothing fancy about the words.

Yet buyers and specifiers of valves everywhere know and respect this simple device, this mark.

Why? Because in all the years since 1864 there has been no compromise in the *quality* of Jenkins Valves. We know it; you know it.

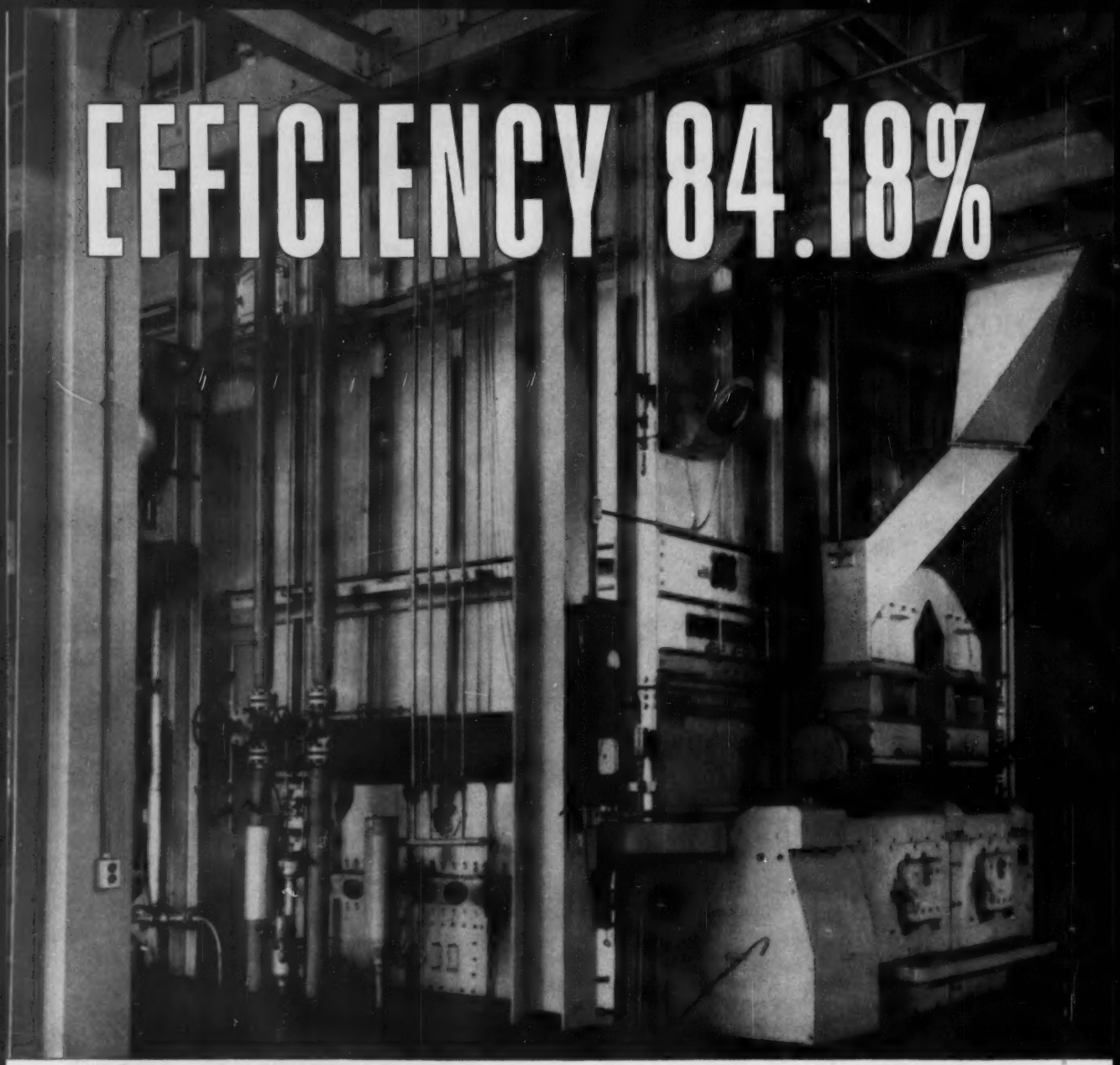
And that is the only way we know to make a trademark *meaningful*. That will always be the Jenkins way of making valves.

JENKINS®

Jenkins Bros

JENKINS BROS., 100 PARK AVENUE, NEW YORK 17

EFFICIENCY 84.18%



Wiley & Wilson, Consulting Engineers
J. L. Hamilton Engineering Co., Installing Contractor

JOB: Supplying steam for space heat, hot water service, hospital needs, and refrigeration at Univ. of Virginia. Campus includes 100 buildings (approx.) plus 600-bed hospital.

STEAM GENERATORS: Two from Union carry the entire load. Recently installed, the one above is a Type VO two-drum unit (72,000 lbs./hr. continuous, 475 psi). Spreader stoker fired. Air heater supplied for heat recovery.

PERFORMANCE: One month's operating log for illustrated unit shows: 33,539,300 lbs. of steam generated. 1,382.5 tons of 14,243 BTU coal consumed. Average evaporation of 12.1 lbs. Max. 8-hr. load of 65,000 lbs. Max. 24-hr. load of 59,000 lbs. *Average efficiency for month — 84.18%.*

MORE FACTS: Many types and sizes of Union Steam Generators are covered in illustrated Bulletin GB-959. Write: Union Iron Works, Erie, Pa.

UNION

steam generators

For more facts circle 818 on Reader Service card, p 207

CRITICAL PIPING FOR THE NUCLEAR AGE

A HOT TEST LOOP OF 10″ INCONEL

PIPED BY MIDWEST

for Knolls Atomic Power Laboratory

Through this project . . . an important "first" in atomic power development . . . Midwest proved conclusively that heavywall Inconel piping can be fabricated and erected to meet the most stringent requirements.

Designed for testing materials and components of pressurized water reactors, this loop was fabricated by Midwest's St. Louis plant from Midwest-manufactured Inconel pipe and fittings, 10¾″ O. D. with a wall thickness of 1″. Other Inconel and stainless welding fittings and pipe, Inconel socket welding fittings and Inconel butterfly valves were also manufactured by Midwest.

Erection of the time- and money-saving prefabricated Inconel piping—all auxiliary piping, the complete electrical power and control system and instruments—was handled entirely by Midwest's competent field erection department.

For complete service . . . welding fittings, shop fabricated piping, and erection service . . . CONTACT MIDWEST.

Write for NEW 20-page bulletin—CRITICAL PIPING FOR THE NUCLEAR AGE—describing Midwest's nuclear experience.

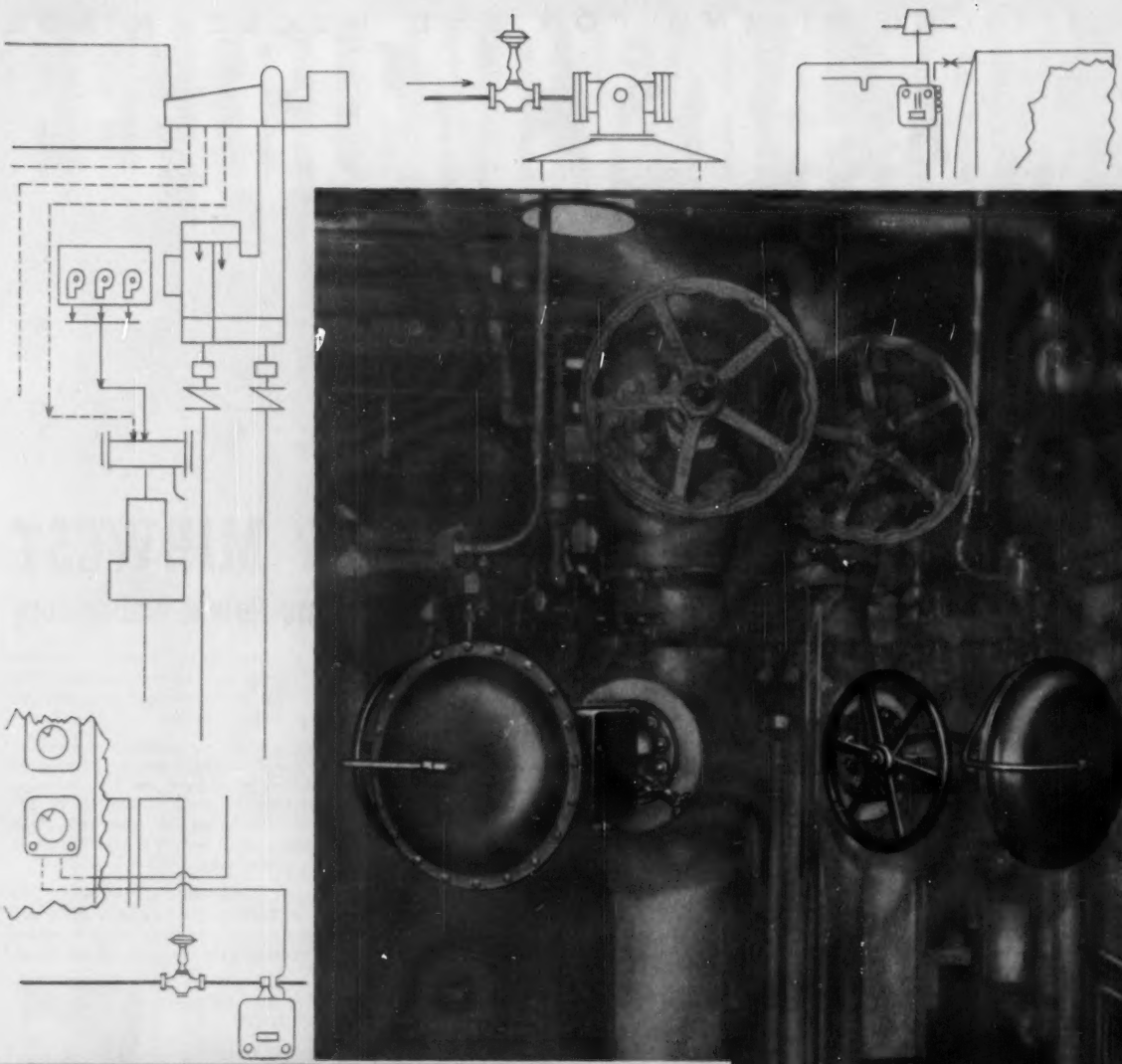
MIDWEST

MIDWEST PIPING COMPANY, INC.

1450 South Second Street, St. Louis, Mo.

8949

For more facts circle 819 on Reader Service card, p 207



Control Valves for Turbine Driven Boiler Feed Pumps

Boiler Feed Water Control Valves Installed at the Shippingport, Pa. Atomic Power Plant.

VERSATILITY OF STANDARD MASONEILAN CONTROLS

Key to Dependability and Economy in Power Plant Operation

The wide variety available in standard Masoneilan Controls, plus adaptability to special conditions (often through interchangeability of unit sub-assemblies), simplifies the selection and maintenance problems of engineers concerned with power generation and power services. For example: —

CONTROL VALVES . . . body and trim types are designed to permit a maximum of interchangeability; full or reduced capacity; with percentage or linear characteristics as required. Advanced design butterfly types are also available with wide choice of actuators, and soft and angle seating.

LEVEL CONTROLLERS . . . units for proportional, proportional-reset, differential-gap control, or for pneumatic transmission, or combinations of any two of these in a single case. Also a complete variety of vessel mounting types.

PNEUMATIC CONTROLLERS . . . non-indicating, indicating and recording instruments for controlling pressure, temperature and flow. Features include unit sub-assemblies for wide choice of function and variety of action.

TRANSMITTERS . . . for pressure, temperature, flow and level, providing accurate remote measurement and pneumatic transmission; featuring a number of exclusive advantages.

Versatility designed into standard Masoneilan products helps to achieve accurate, dependable control with simplicity and economy. It can be profitable to you.

For details call a Mason-Neilan representative, or write:

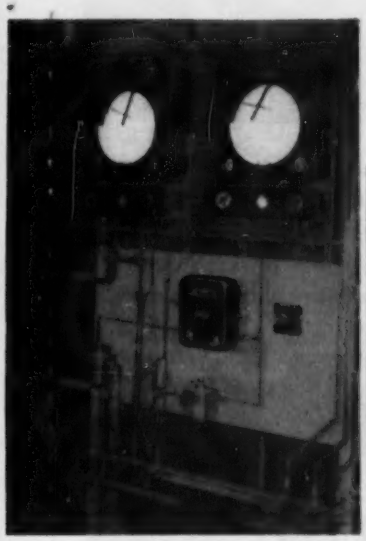
MASON-NEILAN

Division of Worthington Corporation

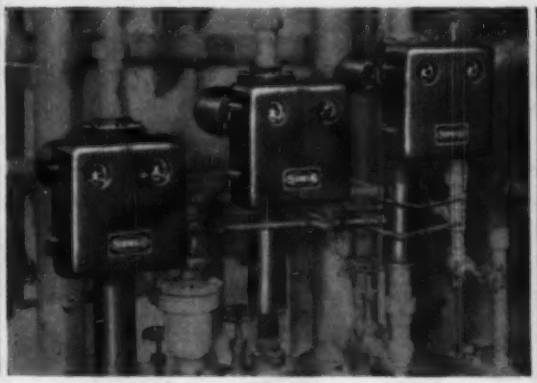
33 NAHATAN STREET, NORWOOD, MASS.

District Offices or Distributors in principal U.S. cities

In Canada: Worthington (Canada) Ltd., Mason-Neilan Division



Pressure and Temperature Controllers

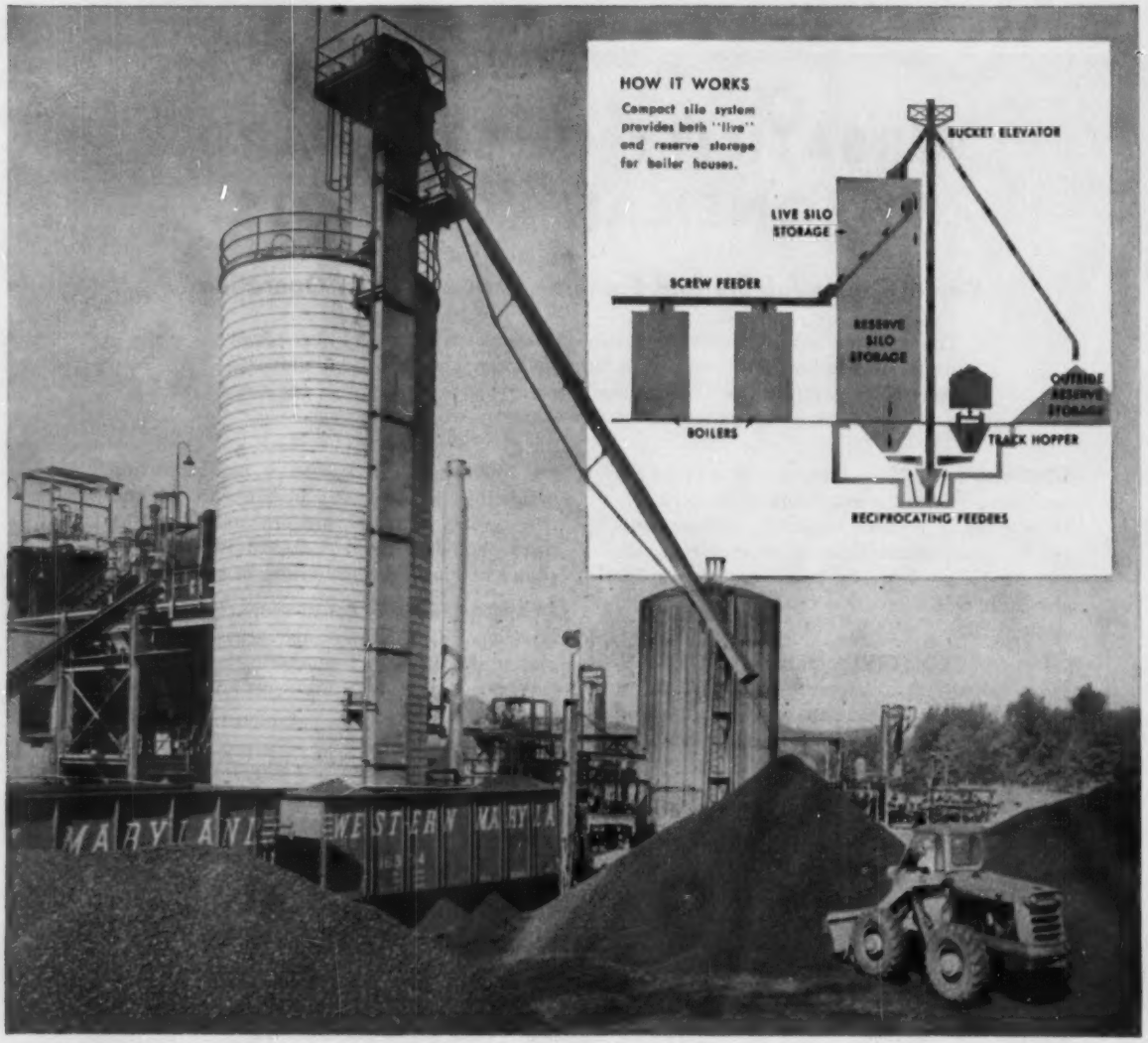


Level Controllers on Condenser Hotwell

Control Valve in Feedwater Starting Service

For more facts circle 820 on Reader Service card, p 207

No boiler house too small to mechanize



Link-Belt coal-handling mechanization can effect new economies for the boiler house that consumes but a few tons of coal per hour. The same handling techniques that have brought significant savings and efficiencies to plants using thousands of tons per hour are applied with equal benefits to small installations.

Backed by virtually unlimited experience in this specialty, Link-Belt engineers can provide a coal-handling system exactly suited to your needs. Costs are kept to a minimum through the use of standardized components matched to capacity and layout requirements.

Next time you have a job that requires movement of materials or the mechanical transmission of power, call the Link-Belt office nearest you. If it involves coal-handling, ask for Power Plant Book 2410, or write LINK-BELT COMPANY, Dept. AV, Prudential Plaza, Chicago 1, Ill.

15,384

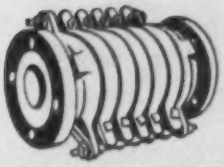
LINK-BELT

Basic products and engineering for industry's basic work

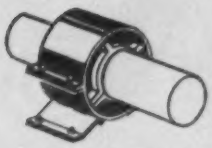
BEARINGS · CHAINS AND SPROCKETS · CONVEYING EQUIPMENT · POWER TRANSMISSION MACHINERY · ENGINEERED (PROCESSING) EQUIPMENT

For more facts circle 821 on Reader Service card, p 207

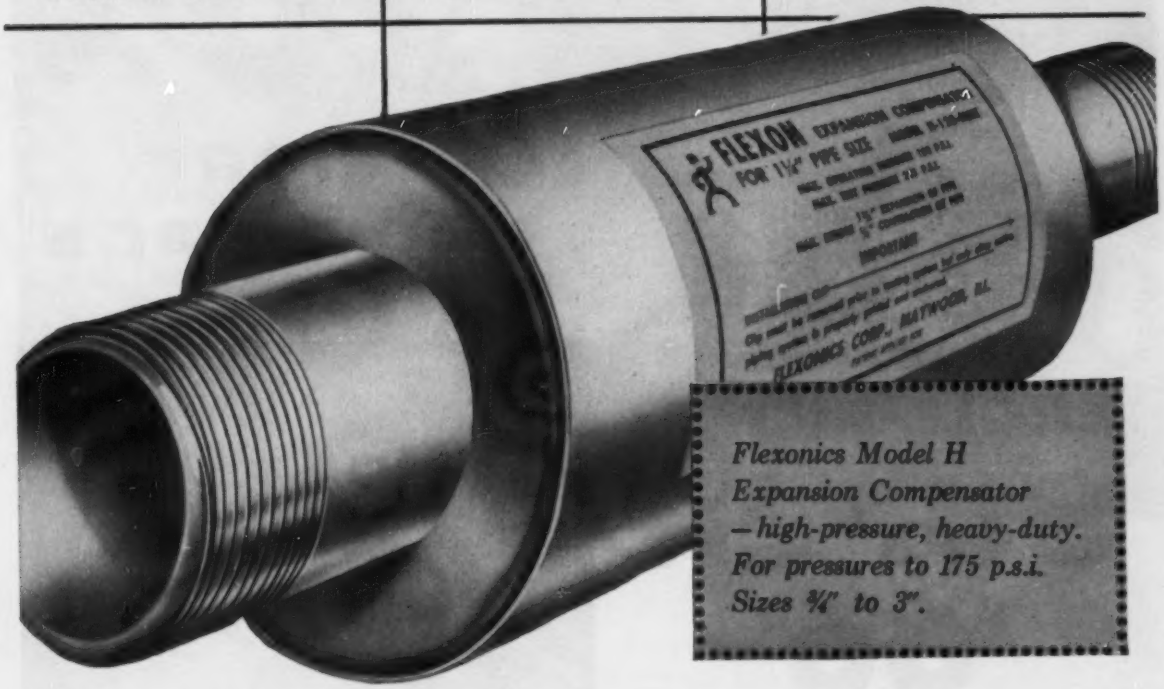
Flexonics Model L Expansion Compensator — to handle pipe and tubing motion up to ½" in low-pressure heating systems.



Flexonics Expansion Joints — controlled-flexing, free-flexing, and many special types, in an unlimited range of sizes.



Flexonics Pipe Guides — a completely new and better way to keep pipe in alignment. Positive, rugged, inexpensive.



Flexonics Model H Expansion Compensator — high-pressure, heavy-duty. For pressures to 175 p.s.i. Sizes ¾" to 3".

INCH FOR INCH, THE LOWEST-COST WAY TO TAKE UP PIPE EXPANSION

Any way you look at it, the Flexonics Model H Expansion Compensator *costs less* — costs less per inch of stroke than any other way to handle pipe motion — costs less after it's installed because it never needs maintenance.

Yet the Model H is built for hard service. Its 2-ply stainless steel Flexonics bellows is designed to outlast the building. Steel-encased and heliarc welded for full protection from external damage. Positive internal guide and anti-torque device. Completely packless. No servicing necessary after installation.

These are the reasons why engineers and piping contractors are specifying the Flexonics Model H for thousands of industrial piping jobs that use pipe up to 3" and require up to 2" total movement at each Expansion Compensator. Working pressures to 175 p.s.i. for ¾" and 1" sizes; to 125 p.s.i. for larger sizes up to 3".

Make the Flexonics Model H Expansion Compensator a cost-cutting part of your next piping job.

Today—write for informative and helpful Engineering Guide No. 222-B.

EC-150

Flexonics
corporation

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ont.

EXPANSION JOINTS · METAL HOSE · SYNTHETIC HOSE · BELLOWS · AERO/SPACE COMPONENTS

SUBSIDIARY OF CALUMET & HECLA, INC.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

FLEXONICS CORPORATION
1301 South Third Avenue
Maywood, Illinois

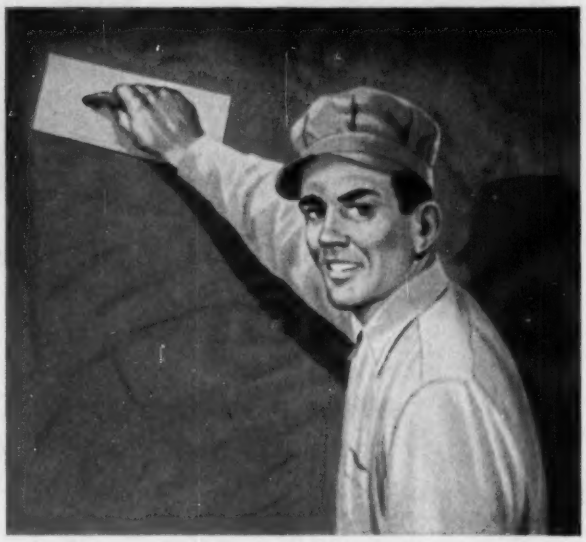
Please send me my personal copy of Flexonics Engineering Guide No. 222-B, including full information on using Flexonics Expansion Compensators to absorb pipe movement.

For more facts circle 822 on Reader Service card, p 207

You get 20% MORE COVERAGE

with EAGLE-PICHER SUPER "66" insulating cement

for temperatures up to 1800 F.



Because Super "66" Insulating Cement gives you less shrinkage (volumetric shrinkage wet to dry only 18½%), you get up to 20% greater dry coverage (50-55 bd. ft. per 100-lb.), with uniform thickness for better protection and strength. Result: You save warehouse space, time and labor costs.

Eagle-Picher Super "66" Insulating Cement *sticks to hot or cold surfaces.* It contains a special rust inhibitor that actually *prevents corrosion.* In addition Super "66" is easy to apply . . . reclaimable when used to 1200 F . . . and offers one of the most effective thermal barriers known. Super "66" can be applied on irregular shapes and usually requires no reinforcing on applications up to 1½ inches thick.

Eagle-Picher produces a line of industrial insulations for all temperatures from below zero to over 2000 F. See our complete catalog in Sweet's Plant Engineering File or write for descriptive material.

Since 1843

EAGLE EP PICHER

EAGLE-PICHER

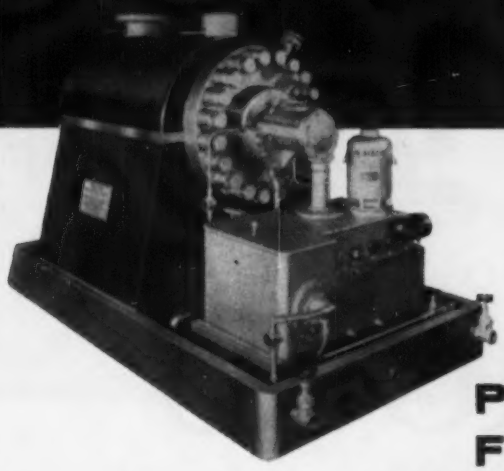
The Eagle-Picher Company • General Offices

Dept. P-1060 • Cincinnati 1, Ohio

Member of National Insulation Manufacturers Association

For more facts circle 823 on Reader Service card, p 207

Under this dome at Dresden Nuclear Power Station, Pacific pumps, like the one below, aid in atomic generation of electricity.



PUMPS FOR AN ATOMIC GIANT

PACIFIC feed pumps . . . chosen for nation's largest nuclear power plant

Dresden Station . . . newest and largest operating atomic power plant in the United States . . . generates 180,000 kilowatts of electricity capable of serving a city of over 200,000 . . . a part of the Commonwealth Edison system in Northern Illinois . . . another milestone in the application of atomic energy for peaceful purposes.

Pacific pumps fill the bill at the General Electric-built Dresden plant, as they do wherever the demand exists for long-lasting, unfailing pump performance.

Pacific Pumps, Inc., is one of the twelve operating companies of Dresser Industries . . . all well known for the reliability of their equipment and services. These companies, with their diversified skills, serve the electric, oil, gas, water, paper, chemical, electronic and general industries the world over. Working individually or as a team, Dresser companies are given full support in the parent organization which encourages imagination and initiative in developing better products and services attuned to technological progress.

TOMORROW'S PROGRESS
PLANNED TODAY BY
MEN WITH IMAGINATION

DRESSER
INDUSTRIES, INC.
EQUIPMENT AND TECHNICAL SERVICES
ELECTRONIC CHEMICAL INDUSTRIAL GAS • OIL

P. O. BOX 718 • DALLAS 21, TEXAS

For more facts circle 824 on Reader Service card, p 207

cost

CONSOLIDATED SAFETY VALVES relieve overpressures automatically at extremely low cost per pound of steam discharged

Consolidated Safety Valve, Type 1511 Series. Cast iron body. Maximum capacity for saturated steam. Sizes: 1½" thru 6". Pressures to 250 psi. Temperatures to 450° F. ASME Standard. ASME Tested. National Board Certified.

conscious

Cost-conscious engineers provided maximum capacity in minimum flange size when designing the compact Type 1511 Consolidated Safety Valve. This innovation makes it practicable to reduce the number and/or size of safety valves per boiler. You also have the advantage of smaller, less costly discharge piping.

Fine blowdown adjustment, few working parts, and the positive tightness of optically flat seating add to the total economy of these tough, long-life valves. Get complete technical data and select from the Type 1511 Series the Consolidated Safety Valves that best meet your needs. Write for Bulletin 730.

Industrial distributors in all principal cities are backed by our convenient regional warehouses to give you prompt delivery on the Consolidated valves of your choice.

MANNING MAXWELL & MOORE M&M TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

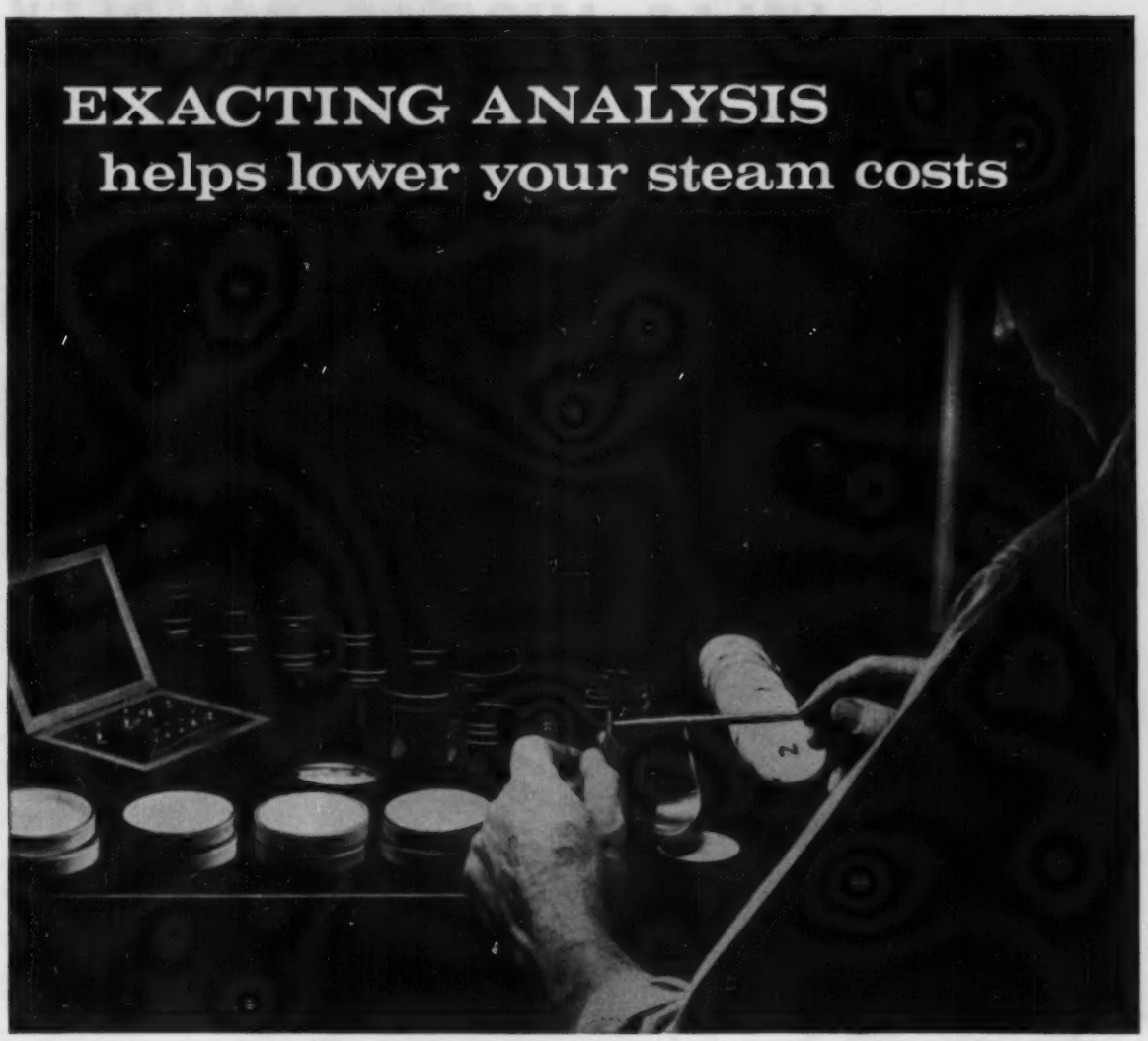
MANNING, MAXWELL & MOORE, INC.

Valve Division • Stratford, Connecticut

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 825 on Reader Service card, p 207

EXACTING ANALYSIS
helps lower your steam costs



An integral part in the preparation of Valley Camp Quality Coals is an exacting analysis for ash, moisture, and other undesirable materials. This constant quality control helps us to prepare coals with a high degree of uniform heat content, resulting in lowered steam costs for many plants.

Ask our combustion engineering service to show how such analysis can pay off in lowered steam costs for you.

THE VALLEY CAMP COAL COMPANY

Western Reserve Building • Cleveland 13, Ohio

SUBSIDIARIES —

Great Lakes Coal & Dock Co., Milwaukee, Wis. • Great Lakes Coal & Dock Co., St. Paul, Minn. • The Valley Camp Coal Co. of Canada Ltd., Toronto & Fort William, Ont. • Kelley's Creek & Northwestern Railroad Co. • Kelley's Creek Barge Line Inc. • Pennsylvania & West Virginia Supply Corp.

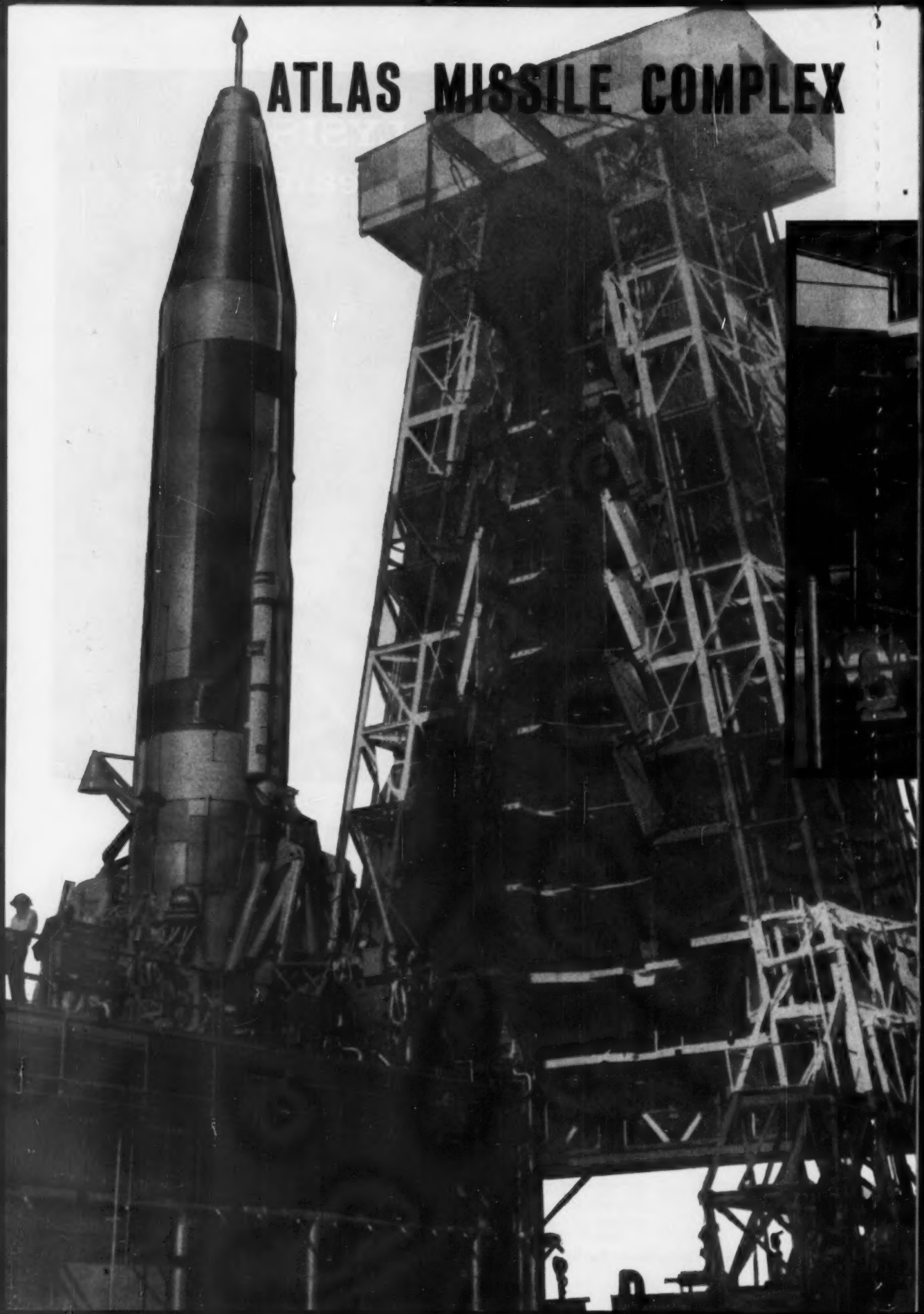
SALES OFFICES —

Philadelphia • Baltimore • Buffalo • Pittsburgh • Wheeling • Cleveland • St. Paul • Cincinnati • New York • Milwaukee • Superior, Wis. • Fort William, Ont. • Toronto, Ont.

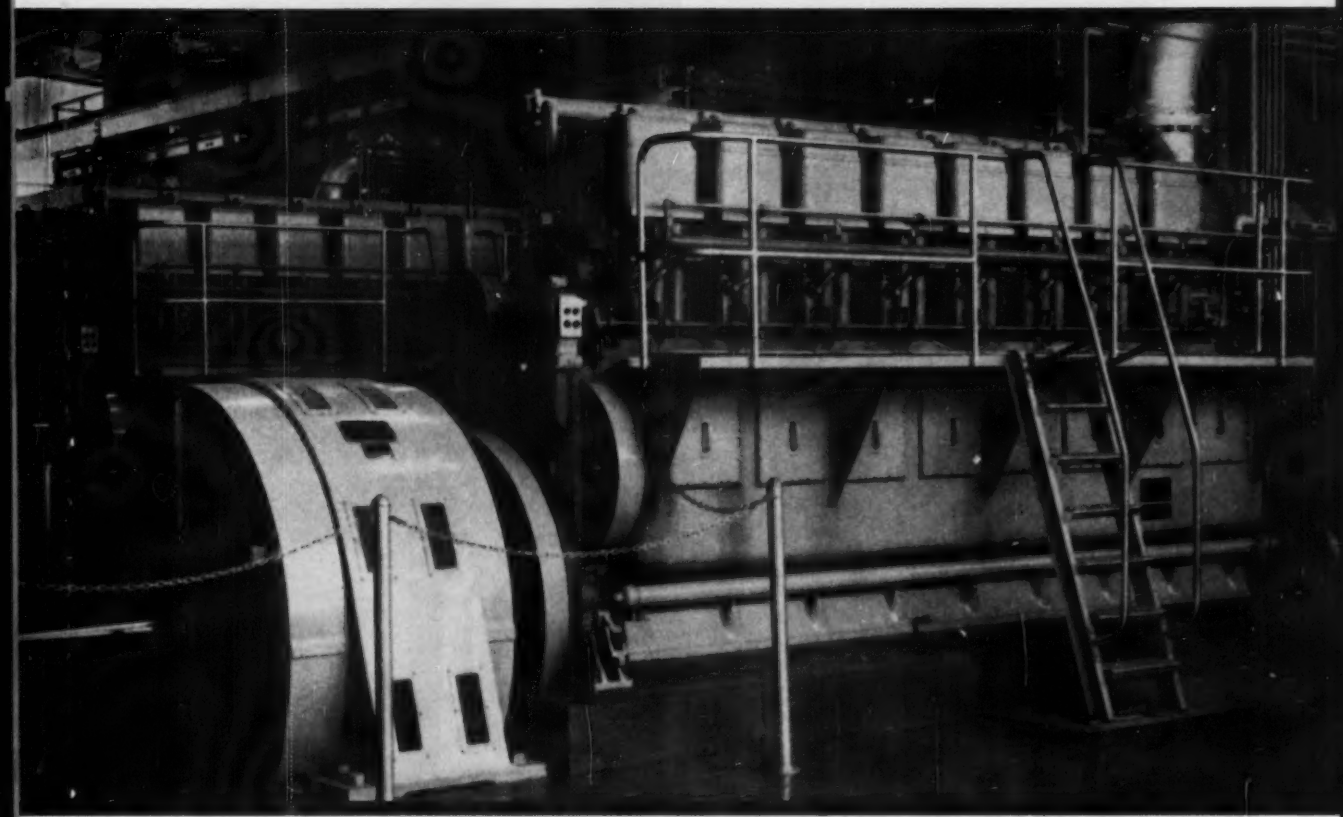
For more facts circle 826 on Reader Service card, p 207

Circle 827 on Reader Service card for following ad ➤

ATLAS MISSILE COMPLEX



...UNFAILING POWER SUPPLY assured with 6 NORDBERG DIESELS



The locale . . . an isolated point of land jutting into the Pacific Ocean near Los Angeles. Sprinkled through this brush-covered area is the incongruous evidence of the free world's first operating and training base for both intercontinental (ICBM) and intermediate range (IRBM) ballistic missiles. Suddenly, the area has sprouted towering gantries, huge concrete slabs, a busy air field, shops and offices, homes and barracks. This is Vandenberg Air Force Base, which has mushroomed into a populated, multi-billion-dollar aero-space age defense establishment.

The major mission of Vandenberg is to maintain an operational status with ICBM's. The base must be ready at a moment's notice to blast off its "birds" without fail. Vandenberg also serves as a training site for SAC ICBM crews to be deployed at bases throughout the country.

To insure an unfailing power supply, the Atlas Complex includes a modern power plant, comprised of six husky Nordberg turbocharged diesels rated 1344 hp at a conservative 450 rpm, giving the plant a total capacity of 8,064 hp. Each engine drives a 956 kw generator, and the total capacity of over 5700 kw gives the plant plenty of reserve capacity . . . a Nordberg diesel-electric generating plant that assures the world that no electric power failure will delay the gigantic Atlas guided missiles if they must soar into space in any emergency.

NORDBERG MANUFACTURING COMPANY
MILWAUKEE 1, WISCONSIN

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS
NEW ORLEANS • NEW YORK • ST. LOUIS • SAN FRANCISCO • TAMPA
WASHINGTON • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

©1960, N.M.CO.

P680

Utilizes Westinghouse "failure-free" diodes

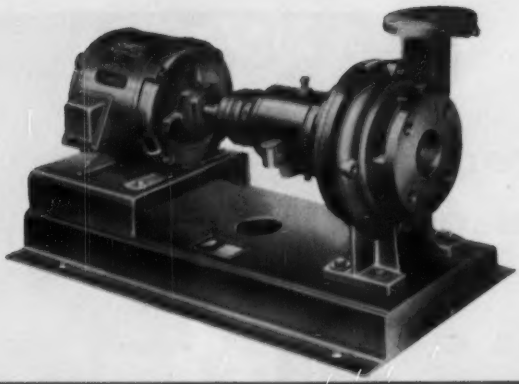
25% MORE EFFICIENT

buell
Norblo®

You get more power...reduce maintenance...increase reliability when you convert to Buell Silicon Rectifier Units

Buell Silicon Rectifier units can increase efficiency of your rectifiers 25% or more ■ Perfected and specifically designed for fast, simplified conversion of existing mechanical or tube rectifiers ■ They cut operating costs, reduce overall maintenance ■ Enable more efficient utilization of power ■ Eliminate rectifier maintenance ■ Reduce outages ■ Reclaim plant space ■ Suitable for indoor or outdoor installation ■ For only a small investment you can materially improve your rectifier performance ■ For details of the unit and a specific proposal write: Buell Engineering Co., Dept. 50-J, 123 William Street, New York 38 ■ Northern Blower Division, 6428 Barberton Ave., Cleveland, Ohio ■ CYCLONES, ELECTRIC PRECIPITATORS, BAG COLLECTORS, COMBINATION SYSTEMS, CLASSIFIERS, FANS.

For more facts circle 828 on Reader Service card, p 207

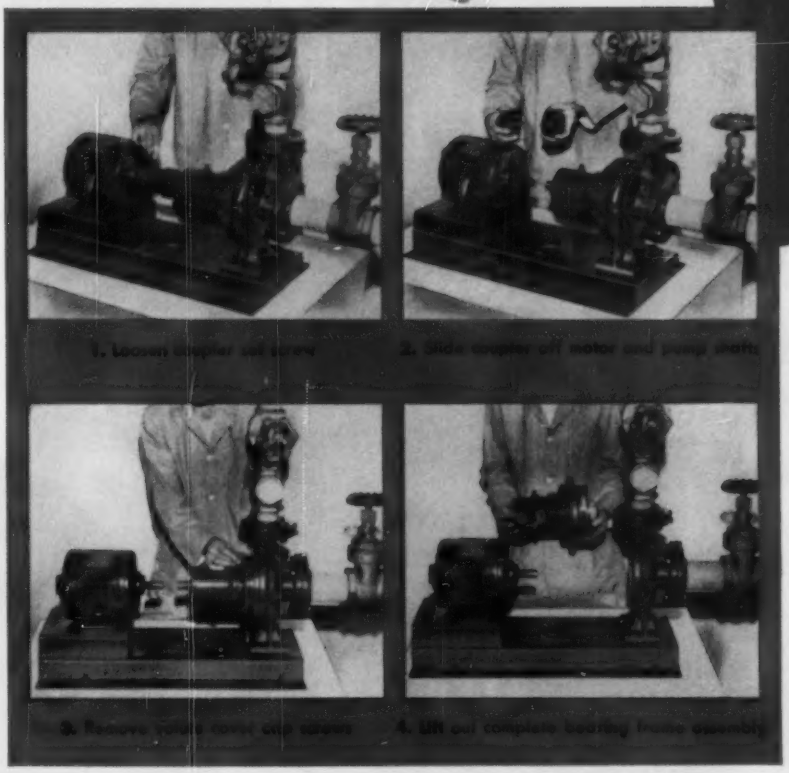


EASY TO SERVICE

THIS VERTICAL SPLIT CASE PUMP

offers all the advantages of horizontal split case pumps

B & G SERIES 1510-B CENTRIFUGAL PUMP



The photos show how easily the complete bearing frame, including seal and impeller, can be removed without disturbing piping or motor leads. The unit is replaceable and interchangeable in all pump sizes within limits of material construction.

Other features of the 1510-B include—

Mechanically balanced impeller. Balancing chamber and pressure relief holes in the impeller reduce thrust to a minimum, lengthening pump life.

Solid-type volute with support foot. Can be left in pipe line when servicing pump—rugged construction absorbs piping strains.

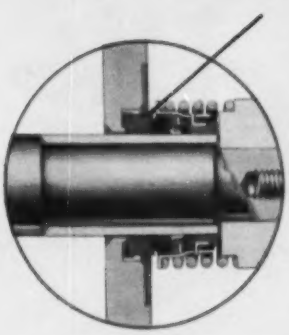
Anti-friction roller bearings. Timken bearings handle thrust and radial loads for smoother, quieter, more efficient operation.

Oil lubrication. No messy, undependable grease cups—circulating oil lubrication assures positive protection to bearings. Oil level indicator permits visual check.

Rugged steel base. Base mounted construction provides a sturdy platform for proper pump and motor alignment.

100% factory tested. Every pump hydraulically tested to meet specified conditions of head and capacity.

Capacities. To 2000 GPM, heads to 420 ft. 1¼" through 8" discharge.



LEAK-PROOF REMITE® SEAL

...eliminates the customary leakage which occurs when a packing gland is used

This exclusive feature assures long, trouble-free life. A carbon seal ring faces on a "Remite" floating seat—a material developed by B&G, so hard it will scratch glass—wear-proof and corrosion-resistant.

This mechanical seal is self-lubricating. A synthetic rubber bellows seals the shaft. Metal parts are of steel, bronze or stainless steel, depending upon the type of service.

STOCK PUMPS FOR QUICK SERVICE

Selected sizes of B&G Series 1522, 1531 and 1510-B Centrifugal Pumps are stocked at the factory for immediate shipment. Capacities to 550 GPM, heads to 180 ft. Send for Price and Selection Catalog.

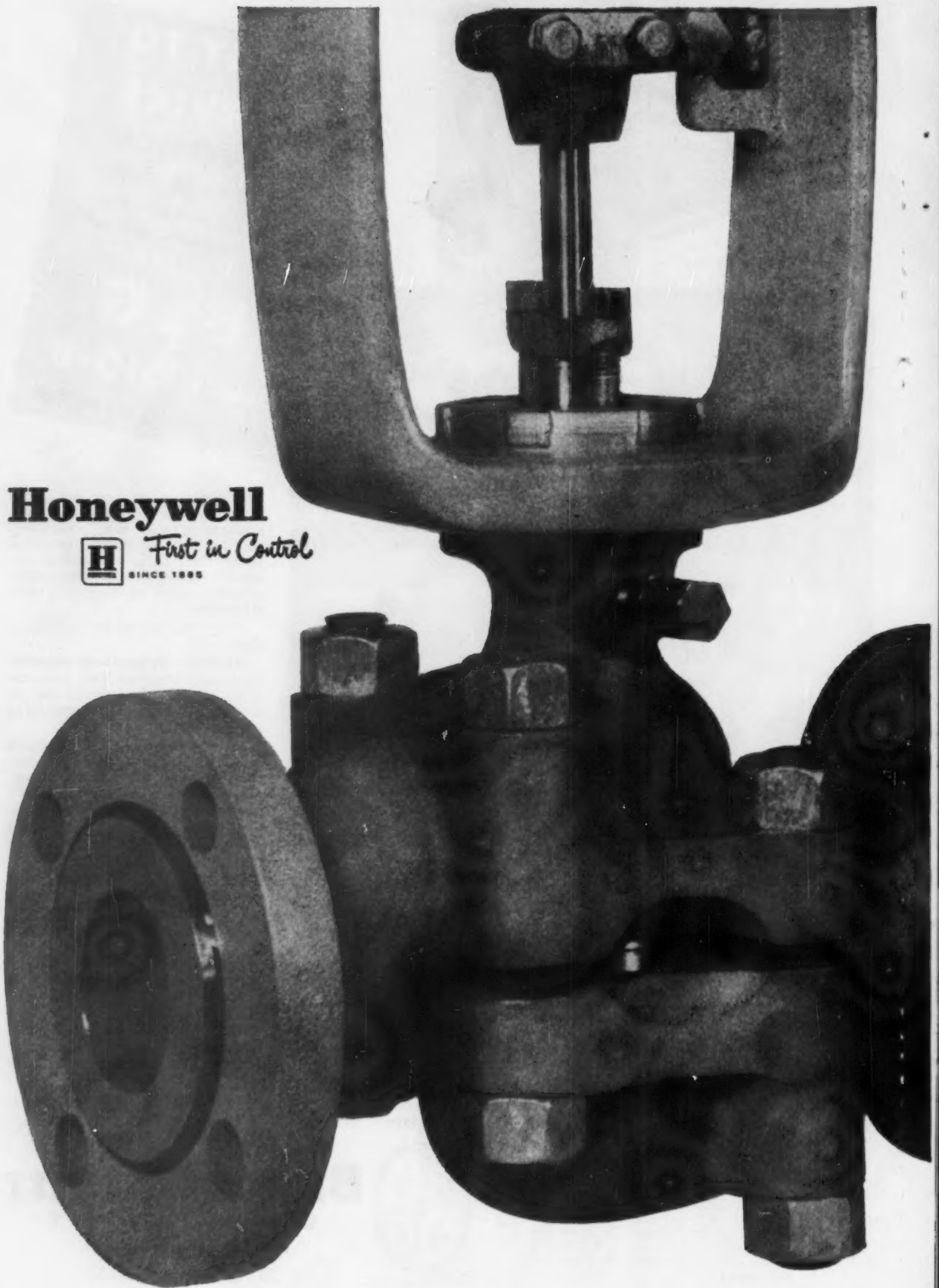
Reg. U.S. Pat. Off.

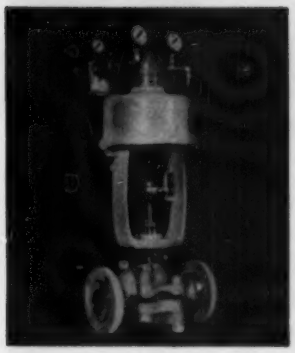
BELL & GOSSETT COMPANY

Dept. GJ-36, Morton Grove, Ill.

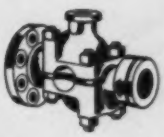
Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

For more facts circle 829 on Reader Service card, p 207


Honeywell
First in Control
SINCE 1885



Now, a new split-body valve makes possible a flexible intermix of Honeywell valves and actuators—a combination designed for both economy and perfect matching of valve to application. For example, you can get the split-body valve with cost-cutting, clamped-in seat rings, separable flanges and the new cylinder actuator. Or perhaps your application calls for the split-body with fixed flanges and the economical diaphragm actuator. With high temperatures, you'd probably prefer this globe body valve, with either the cylinder or diaphragm actuator. In any case, the completeness of the Honeywell line lets you select the valve-actuator combination that's exactly right for the job... without pushing a valve beyond its design limits, without paying for more than you need. Write for Bulletin B-802-1.



75th YEAR — SERVING THE FUTURE

Minneapolis-Honeywell, Fort Washington, Pa.

For more facts circle 830 on Reader Service card, p 207

Monel alloy feedwater heater tube (shown emerging at lower right) is being ultrasonically scanned. If imperfection shows up, signal stops drive and operator shunts tube into discard rack.

How the Immerscope test assures trouble-free Monel tubes for high pressure feedwater heaters

With an ultrasonic ear sharply tuned, the Immerscope you see above inspects every inch of every length of Monel* nickel-copper alloy feedwater heater tubing produced at Huntington Alloy Products mill.

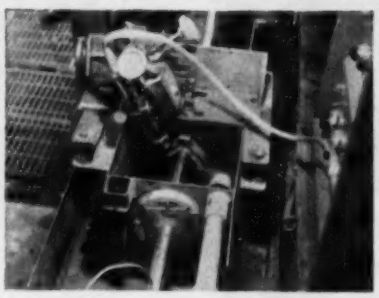
And this is only one of a number of places where forgings, extruded tube shells, and the tubes in various dimensions are carefully checked.

In the Immerscope test, a probe beams ultrasonic waves into the rotating tube as it is driven slowly through water. Any deviation from standard is translated into a pip on an oscilloscope. Just one pip and the drive cuts out. A horn blows alerting the operator to remove the tube.

Precision-made and precision-tested, Monel alloy tubes meet today's needs – they have the strength it takes to handle high pressures and temperatures in modern steam plants. Monel alloy tubes are corrosion-resisting and have good heat transfer properties. They are workable and weldable—easily joined to tube sheets.

Keep Monel alloy in mind, whether it be in the designing stage or retubing. Huntington supplies tubes in lengths up to 85 feet, pre-bent if desired. Prompt delivery can be assured on urgent jobs. *Inco trademark

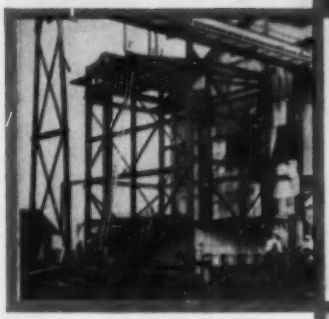
HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17, West Virginia



Ultrasonic probe sends sound waves into the metal where waves bounce back and forth between inner and outer surface of tube (shown left) until 100% of tube has been inspected.

MONEL.

U. S. PLYWOOD solved its need for greater steam capacity *with a*



U. S. PLYWOOD CORPORATION
ROSEBURG, OREGON

one of the world's
foremost manufacturers of Plywood

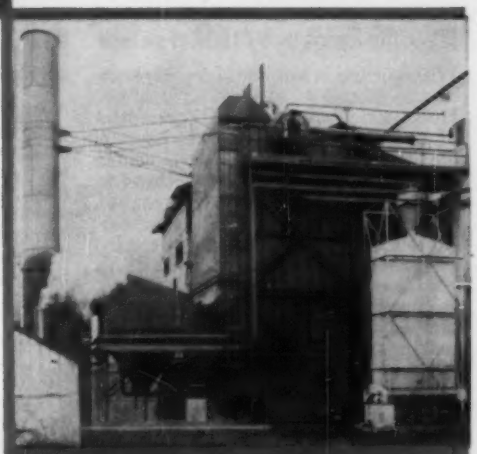
steam plant expansion and modernization
designed by U. S. Plywood Corporation staff

— Mechanical Contractors —
BUMSTEAD-WOOLFORD CO.
Seattle—Portland—San Francisco—Los Angeles—Vancouver

KEELER MK

water tube steam generator

available in capacities from 12,000 to 200,000-lb stm/hr



THE PROBLEM...

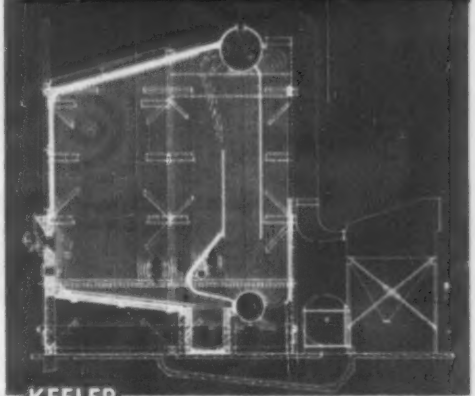
Sawmill, dry kiln and plywood manufacturing operations required greater, more flexible steam capacity to supply varying loads *(40,000 to 105,000 lbs/hr at 250 psi)*. Existing facility inadequate. Single unit must be suitable for firing plant's "hogged fuel" by-product.

THE SOLUTION...

An outdoor installation of a Keeler Type MK Water Tube Steam Generator—124,000 lbs/hr capacity, 275 lbs design pressure for solid fuel firing. The Keeler MK was erected in close quarters adjacent to old boiler house without interrupting plant's work schedule.

OPERATIONAL REPORT...

Keeler MK supplying entire steam requirement with capacity to spare. Functioning properly, operating economically, giving trouble-free performance. *Over-all requirements fully met with complete satisfaction.*



KEELER MK

All purpose cross drum water tube type steam generators provide high efficiency with any method of firing—for coal, oil, gas or waste fuel operation (or combinations), with ready convertibility.

There's a dependable Keeler Water Tube Steam Generator available for every requirement—from low cost package units to 80,000 lb/hr and field erected units up to 200,000 lbs stm/hr capacity... for all fuels, all types of firing. *Write for complete data...*

The Seal of Quality in Water Tube Steam Generators

Write For Bulletins

No. MK-1: Type MK Boilers
No. DK-2: Type DK Package Boilers
No. F-14: Type CP Boilers
No. M-2A: Type CPM Package Boilers

KEELER WATER TUBE Boilers

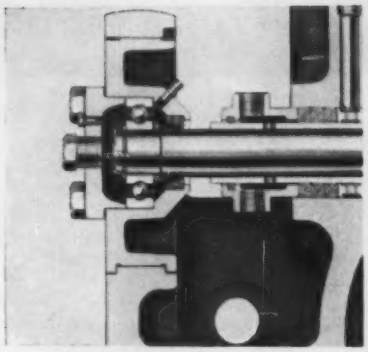
— ESTABLISHED 1864 —

E. KEELER COMPANY
200-300 West St., Williamsport, Penna.
— OFFICES IN PRINCIPAL CITIES —
In Canada: Canadian Vickers, Ltd., Montreal, P. Q.

For more facts circle 832 on Reader Service card, p 207

PUMPAGE

Goulds news about pumps for process industries



When life hangs by 5/1000 of an inch

Whether life is long or short depends on the proper fit of shaft to bearing. Destroy the fit by 5 to 10 thousandths of an inch—and you shorten bearing life. Therefore Goulds pump shafts are ground and polished to within the tolerances specified by bearing manufacturers. To insure complete accuracy, bearing housings are bored by a special machine. Careful handling when removing and replacing bearings in the field will also go a long way toward protecting fit and helping bearings live to a ripe old age.

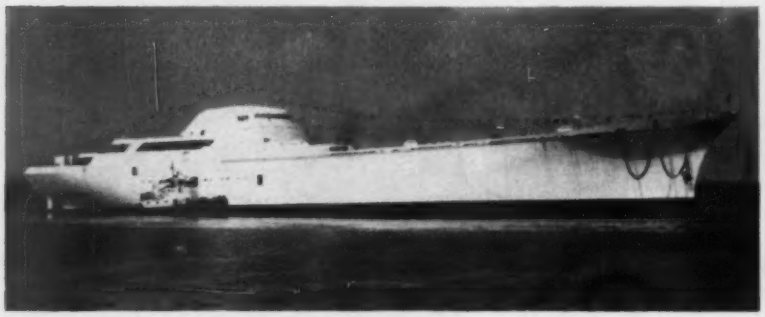
Now... ISO-40 to guard against corrosion and abrasion

A stainless of great strength, ISO-40* alloy survives under some very harsh conditions. Strongly oxidizing nitric solutions don't faze it. It's a match for 50% sulfuric at r.t. It resists corrosion, abrasion, high shock. Can be furnished with a B.H.N. hardness of 320, tensile strength of 145,000 psi. A pump with an ISO-40 impeller circulated a slurry of sodium sulfite and sodium carbonate for 17 months with negligible impeller damage. Speaking of pumps, did you know you can get Goulds chemical pumps in ISO-40?

*Registered trademark of Empire Steel Castings, Inc.

Circulating crude phthalic anhydride

One company does it with two Goulds Model 3171's. Each delivers forty gallons a minute of this sluggish solid (sp. gr. 1.2) from a depth of 11 ft. at temperatures from 300 to 525 F. How? The discharge pipe, which extends from pump through pit cover, wears a steam jacket. Temperature stays up—phthalic anhydride stays fluid. The long pipe has a 3″ expansion joint. Additional steam-jacketed pumps of other and varying lengths give flexibility to the installation. For details on how Goulds Model 3171's can help *you* move uncooperative solids, write for Bulletin 726.2.



Nuclear nomad of the seven seas

N. S. Savannah, first atomic-powered merchantman, will call at the seaports of the world as a symbol of the peaceful use of nuclear power. The 21,800-ton ship has a practically foolproof power plant. Its pressurized-water nuclear reactor uses uranium oxide fuel. Goulds Model 3655 (close-coupled centrifugal) pumps the radioactive waste water on both bilge and ballast service. The Model 3655 is available in 23 sizes with capacities to 2000 gpm, heads to 400 ft. Pump and motor are a single, compact unit, easy to install and ready to run. Standardization of parts holds down inventories. For full details, including specifications, construction information and performance charts, write for Bulletin 710.1.

NEW "king-size" vertical... capacities to 3180 gpm

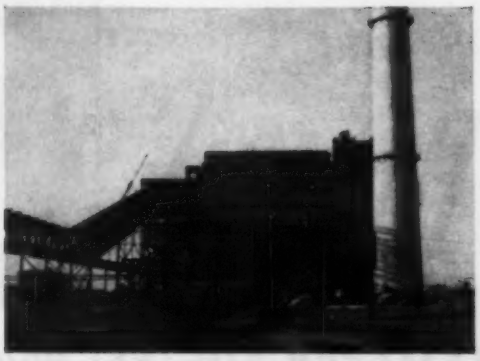
Here are all the details on Goulds newest heavy-duty centrifugal sump and process pump—the "L" size Model 3171. Unit available in 316 stainless and other special alloys. Specifications, sectional views, construction materials, performance curves, dimensions—all are clearly given in Bulletin 726.2. For your copy, write Goulds Pumps, Inc., Dept. PO-100, Seneca Falls, N. Y.

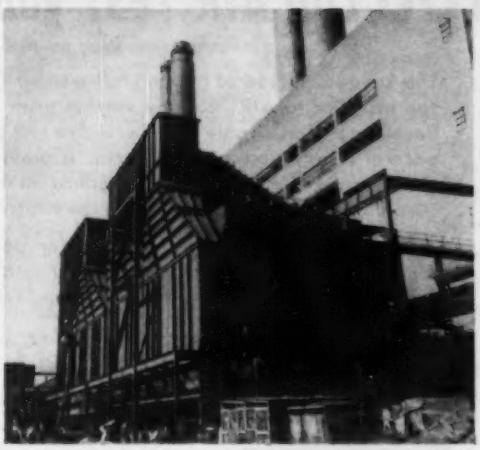
GOULDS PUMPS

99%

GUARANTEED FLY ASH REMOVAL

@ 2,800,000 cubic feet per minute*





** In addition to the Cottrell installations shown, Research-Cottrell has also completed or begun three more large 99% fly ash installations rated at 3,360,000 total cubic feet per minute. Two of these are repeat orders based on the excellent performance of those in service.*

Yes—99% is a rigid requirement. And it obviously requires the *best* in Cottrell precipitation equipment.

So—is there any wonder that Research-Cottrell is proud of the fact that they have fly ash precipitators in and operating in full compliance with this specification—also, that Research precipitators are *consistently* chosen for problems of this magnitude.

Research is the *only* company that can point to several large 99% fly ash installations. What's more—*repeat orders* give further proof of the high quality of the equipment and the high degree of performance of the Research precipitators.

So, for your own fly ash collection problem, doesn't it make good sense to place your confidence in the company and equipment with this proven performance?

Research-Cottrell

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, N. J.

Representatives in principal cities of U.S. and Canada

RESEARCH COTTRELL INC. TRADE MARK

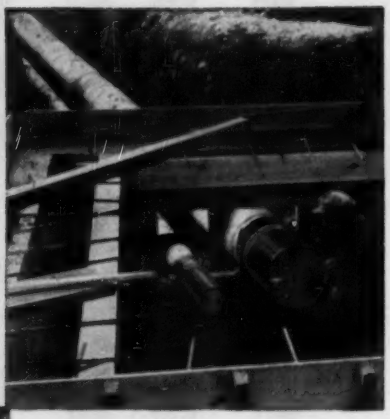
RC-813

For more facts circle 834 on Reader Service card, p 207

MR. ENGINEER:

LET'S FACE THE FACTS . . .

Can you be sure your underground piping system is watertight if you can't *AIR TEST* it?



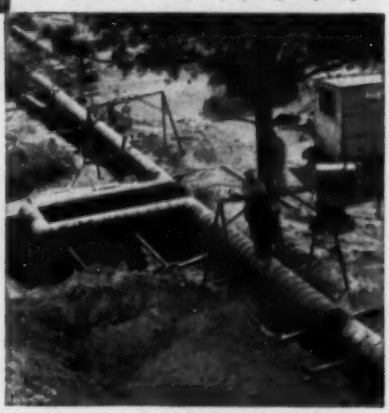
Test caps applied to unit ends for air testing full-welded conduit system.

WITH

RIC-WIL

During air test, conduit field welds are checked with soap solution.

Tested and ready for lowering long lengths.



YOU can AIR TEST your system...

The RIC-WIL method of making full-welded field closures allows the installer to AIR TEST the system prior to completion and backfilling. This simple 15 lb. pressure test gives greater assurance of a tight, leak-proof system. It provides the finest practicable protection to the owner against an initial system failure ...and most important, the long range effects of water corrosion.

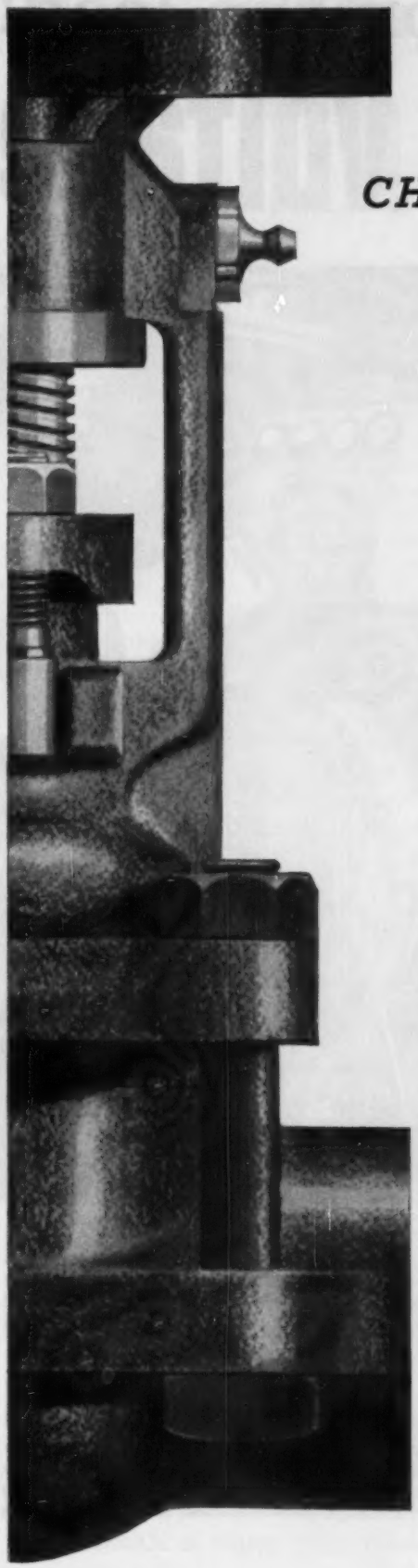
Ask a RIC-WIL field representative for detailed information regarding Air Test procedure or write for catalog covering recommended field installation details . . . and remember, it pays to do it RIGHT the first time . . .

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency
SINCE 1910

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

CENTRAL OFFICE: RIC-WIL INCORPORATED, BARBERTON, OHIO
WESTERN STATES: WESTERN RIC-WIL COMPANY, NEWARK, CALIF.
IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

For more facts circle 835 on Reader Service card, p 207



CHECK OIC FIRST...IT PAYS!

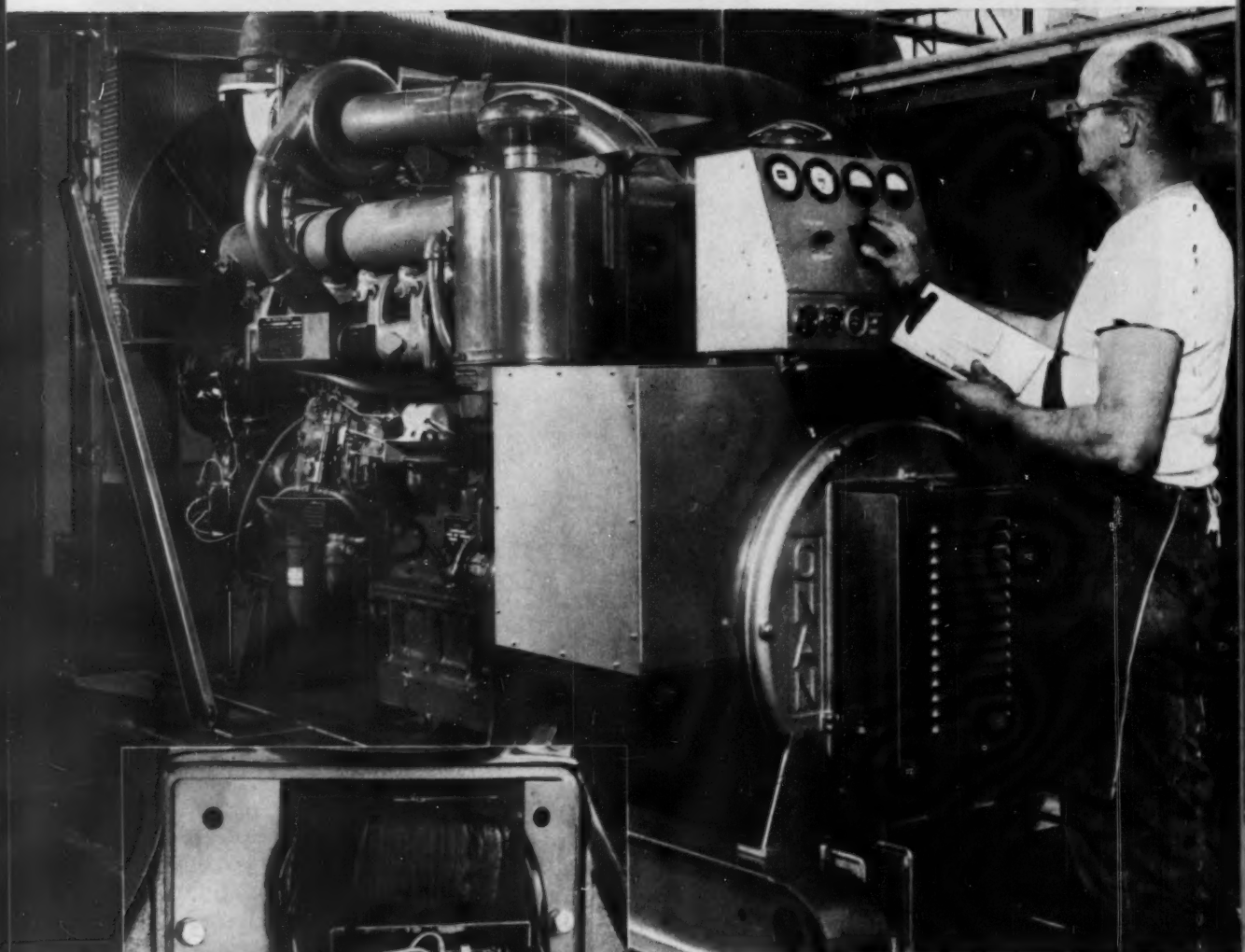
DEPENDABILITY is the *first* consideration when you choose a valve, because the cost of valve failure in down time is almost always greater than the cost of the valve itself. That's why so many of the best distributors sell the OIC line. They know that when they recommend OIC valves, their customers can depend upon them...even in those tough problem installations. Equally important is the distributor's own dependability...his capacity to deliver the valves you need, when you need them. Here, OIC offers the support of a complete factory inventory of bronze, iron, ductile iron, cast and forged-steel valves. You get immediate delivery from your OIC distributor's representative stock, and 4 to 5-day delivery from warehouse or factory. For dependability of product and service, phone your OIC distributor. He has our all-out support in serving you.

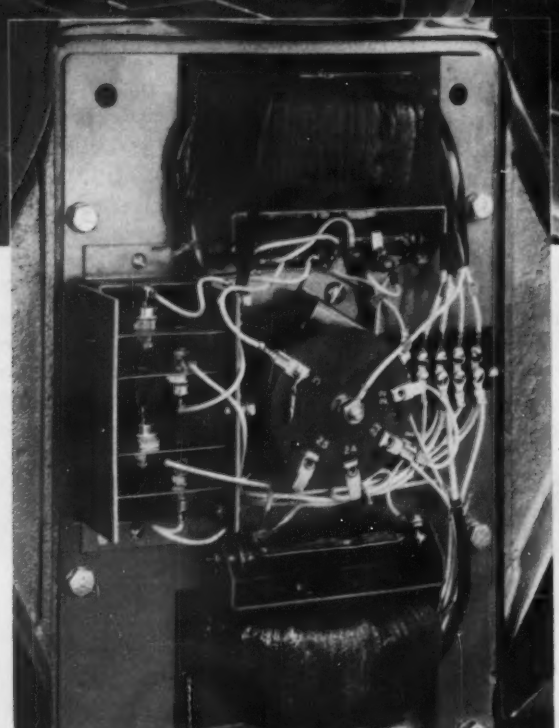
OIC VALVES | FORGED AND CAST STEEL, BRONZE, IRON AND DUCTILE IRON VALVES

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

For more facts circle 836 on Reader Service card, p 207

Pour on the load!
recovers voltage





Use Magneciter-equipped Onan for standby or primary power. Takes maximum starting load without hesitation! Available on all diesel and gasoline-powered Onan Electric Power Plants rated at 25 KW and up.

Static exciter and magnetic amplifier and regulator of Magneciter Generator with cover removed. No moving parts in this *static* exciter and regulator. No extra sensitive adjustments needed. Magneciter means reliability!

Onan Magneciter
within 1 second

Even when maximum starting load is applied, Onan Magneciter gives voltage recovery 5 times as fast as ordinary rotating exciter generator

When a heavy starting load causes a voltage dip, the Onan Magneciter Generator restores full voltage within one second. Old-fashioned rotating exciter generators take more than five times longer. Furthermore, Onan Magneciter has no moving parts in its exciter and voltage regulator, thus eliminating hundreds of potential causes of wear.

It's no longer necessary to buy a generator much larger than your normal power needs just to get enough extra power for the heavy drain of starting motors. Onan gives you this margin of power, builds it into every Magneciter-equipped Onan Electric Plant.

Every Onan Electric Plant is given hours of running-in and testing under load before it is shipped. An independent testing laboratory retests Onan Plants and certifies Onan testing methods—double assurance that every Onan lives up to its nameplate rating. Only then can Onan qualify for its Performance Certification.

Every Onan is ready to give you long-lasting performance and operating economy. See your Onan representative. You'll find him in the Yellow Pages. Or write direct.

ONLY ONAN GIVES YOU THIS CERTIFICATION

PERFORMANCE CERTIFIED
We certify that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.
D. W. ONAN & SONS INC.
Minneapolis 14, Minnesota
Onan

Onan®

World's Leading Builder of Electric Power Plants

D. W. ONAN & SONS INC., 2666 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINN.

For more facts circle 837 on Reader Service card, p 207

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Coal Traffic Manager—Tidewater
Terminal Bldg., Norfolk, Virginia
Telephone MAdison 7-7481
Extension 131

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Raleigh County Bank Bldg.
Beckley, W. Va.
Telephone CLifford 2-6421

ROY L. JOHNSON
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833 Chamber of Commerce Bldg.
Boston 10, Mass.
Telephone Liberty 2-2229

ALVIN JOHNSON
District Manager, Coal Traffic
660 Marquette Bldg., 140 S. Dearborn St.
Chicago 3, Ill.
Telephone RAndolph 6-4634

WINNING "11" - IN THE

RALPH L. HAWKINS
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Extension 423

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Asst. District Manager, Coal Traffic
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St. Louis 3, Mo.
Telephone MAin 1-1180

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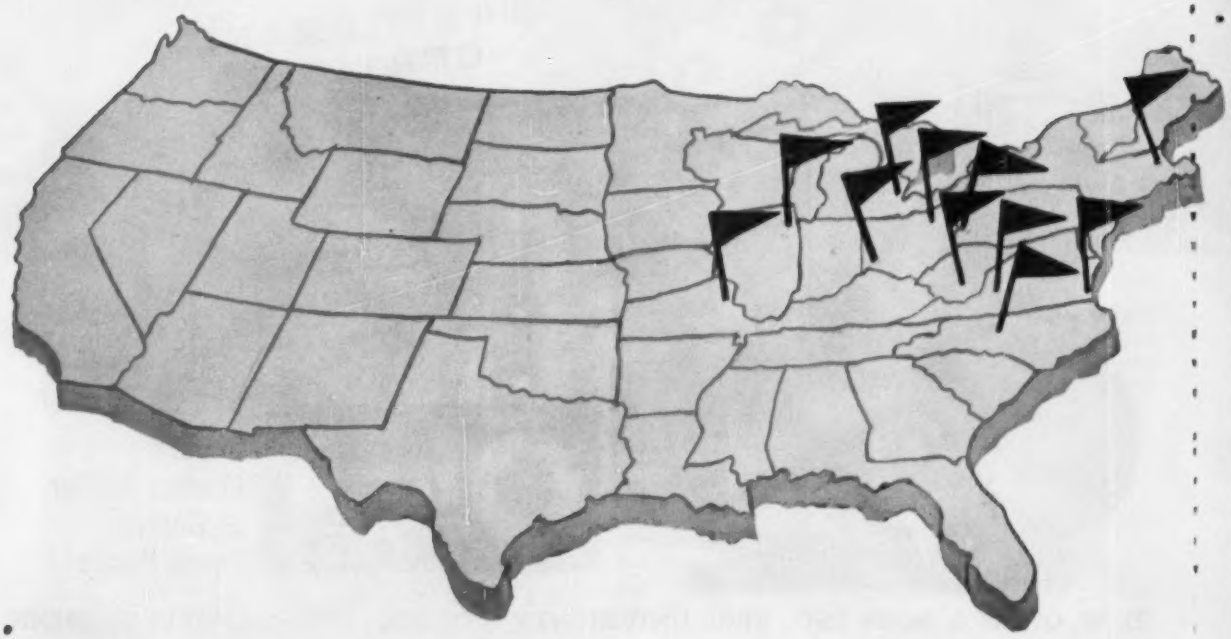
1105 Reynolds Bldg.
Telephone PArk 2-7116
Winston-Salem 1, N. C.



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FIGHT FOR EFFICIENCY

What's the most important job of these 11 Norfolk and Western coal traffic men? Helping you achieve lowest cost per 1,000 pounds of steam! They'll analyze your combustion needs — recommend the coals that most exactly fit your needs and your equipment — suggest changes in methods or equipment to increase your efficiency. Coal's their career and "service," their creed! Let them help you make the most economical use of the nation's most economical fuel!

These N&W coal traffic men are at your service around the clock and through the calendar. Sound, reliable, conscientious, they may double your efficiency but never their talk! Call them . . . any time!

N&W

NORFOLK & WESTERN RAILWAY

General Offices, Roanoke, Virginia

For more facts circle 838 on Reader Service card, p 207

A GIANT STEP FORWARD IN STEAM CONDENSER DESIGN

The size of turbine-generators grows and grows, requiring larger and larger steam condensers. But increasing the size of the condenser shell and adding more tubes is not enough—*the condenser must be designed to make the most efficient use of the cooling surface.*

This is just what C. H. Wheeler's new "Quadruple-Bank" Condenser does. Four tube bundles and 5 steam lanes assure penetration of steam to every square inch of tube surface and minimize pressure losses.

A unique and especially advantageous feature of C. H. Wheeler's "Quadruple-Bank" design is the fact that each tube bundle is provided with its own draft and air cooling section connected to common air removal equipment. This arrangement provides for balanced flow of steam inside the Condenser.

Quadruple-Bank Condensers are available with C. H. Wheeler's special deaerating features, which reduce oxygen content in the condensate to 0.01 cc. per liter, or less. (Our latest deaerating design is expected to produce condensate with an oxygen content of almost zero.)

Consult your local representative, or write our Philadelphia office for more information about condensers and other auxiliary equipment—ejectors, circulating water and condensate pumps, feedwater heaters, evaporators, heat exchangers.

C. H. WHEELER MANUFACTURING CO.

19th and Lehigh Avenue, Philadelphia 32, Pa.

For more facts circle 839 on Reader Service card, p 207

100% inspection of *MegopaK* thermocouples insures strict adherence to factory standards. Manufacturing area is clean, dry, air-conditioned.

Get real economy in mineral-insulated thermocouples . . . specify quality-controlled *MegopaK*

Careful quality control often spells the difference between *real* economy and just another bargain. In small-diameter, mineral-insulated thermocouples, where the art of production is as critical as the science, strict quality control is your only assurance of consistent quality and real economy.

For more information on quality-controlled *MegopaK*, write for Catalog and Price List G100-4 . . . or call your nearest Honeywell field engineer.

Honeywell

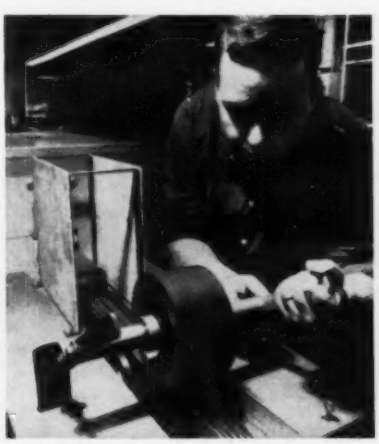
First in Control

SINCE 1885

75th YEAR — PIONEERING THE FUTURE

Insulators are stored in paraffin-sealed boxes, then baked to remove last trace of moisture. Assemblers wear gloves to prevent contamination of thermocouples.

Single-pass swaging of carefully-sized wire-insulator-sheath assembly produces no distortion in wire, insures greater accuracy and longer life.



Continuous hydrogen-annealing not only produces a ductile, brightly finished product, but also identifies improperly compacted material which is rejected during inspection.

BONUS

from the Boiler

POWER

Capital of the World . . .

THE TITUSVILLE-ATLAS

BONUS POWER means maintained high efficiency . . . longer life . . . less maintenance . . . more horsepower per total energy input. That's what you get when you install a complete TITUSVILLE-ATLAS unit, the only boiler with a patented wet back.

Wet-back design gives you maintained efficiency by eliminating back end refractories. *Result:* no down time for replacement.

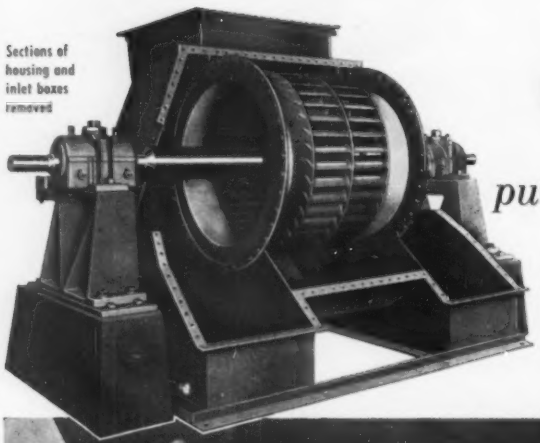
Larger furnace area permits reduced fan requirements. *Result:* lower operating costs. Get BONUS POWER. Specify TITUSVILLE-ATLAS.

THE TITUSVILLE IRON WORKS COMPANY

TITUSVILLE, PENNSYLVANIA

Division of Struthers Wells Corporation

VMA-6966

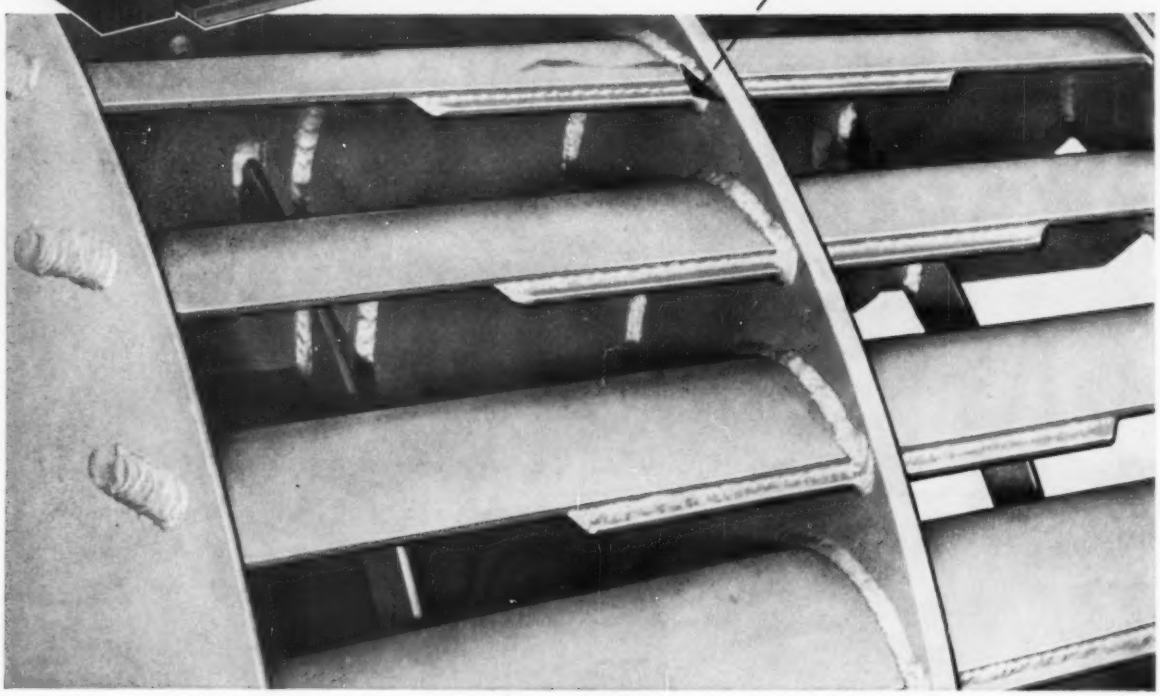


Sections of housing and inlet boxes removed

CLARAGE

puts wearing plates where they belong

on the face of the blades



DON'T SETTLE FOR LESS! Clarage makes sure you get *extra* service life on those punishing induced draft applications.

The Type DN Dynacurve fan, when equipped with wearing plates, has these abrasion-resisting steel plates welded to the *face* of the wheel blades. A distinguishing Clarage feature that guarantees you less maintenance, longer operation! But that's not all.

You get other advantages, and more, with Clarage Dynacurve fans: Minimum floor space and height requirements. Rugged wheel of 36 radially deep, aerodynamically curved blades and tapered rims. *Bolted* scroll liners for easy replacement. High efficiency over a wide performance range.

For *complete* information, contact our nearest office or write for Catalog 905.

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

For more facts circle 842 on Reader Service card, p 207

2

Power reports on . . .

Central-Station Design

Today's and tomorrow's plant-design thinking slowly but surely changes as America's insatiable appetite for electric energy grows. The growing variety of energy needs tests our designers' unfailing ingenuity

Peaking power capacity in today's highly efficient utility systems demands special study to achieve economical results. Low capital charges may be more important than fuel economy. P 146

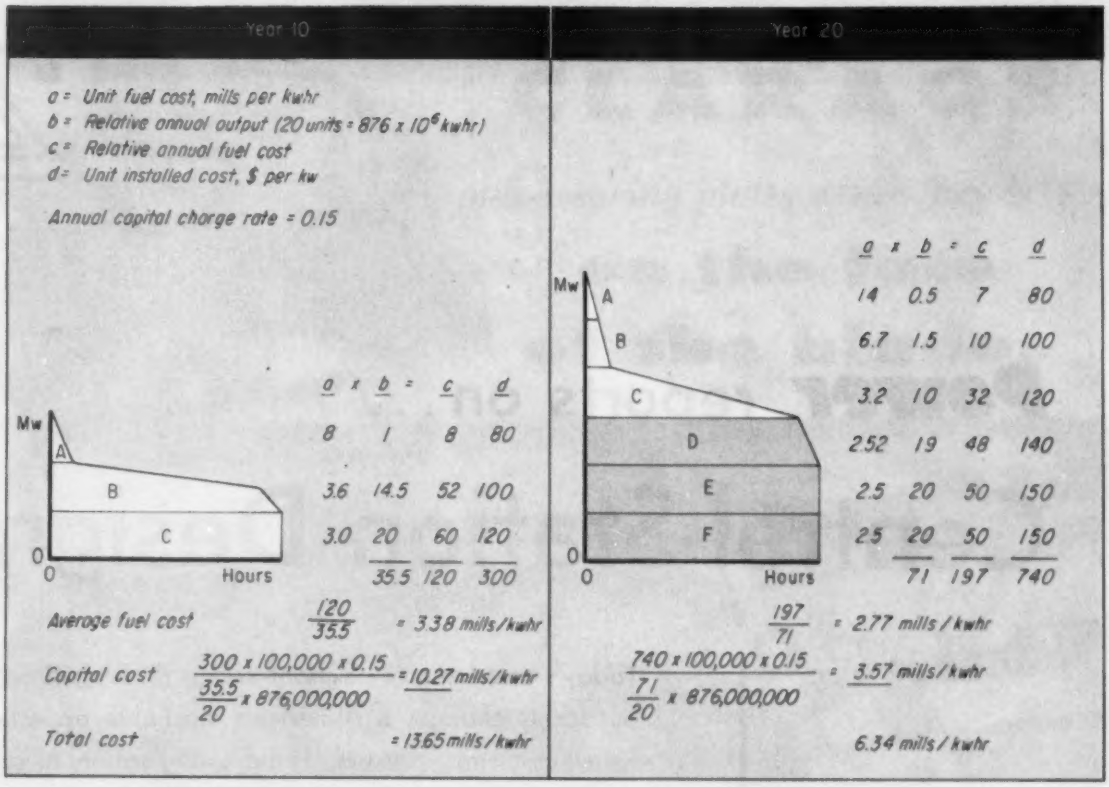
Safety monitoring systems must strive for new highs of dependability as we step across the threshold of plant progress into fully automatic operation of central stations. P 151

Direct electric generation solves many problems for small energy needs and holds out strong promise of sharp changes in power-generation practice for the distant future. P 154

Epicyclic gearing of European design are being tried out in American plants after successful widespread use on the Continent. Major plant equipment will use these gears in U.S. P 156

National power demands will grow by about 5% yearly till 1980 according to Federal Power Commission's latest study. Steam stations will supply the most energy by far. P 158

Main generator leads will be mostly of bus construction rather than cable. Most favored material appears to be aluminum with welded fabricated connections. P 160



PEAKING CAPACITY

. . . saves money on efficient systems

Growing percentage of high-efficiency thermal generating units on the nation's utility systems has led to widespread intense study of another approach to expanding capacity —the peak-load plant. Most systems have annual peak demands lasting only a few hours each year. The ratio of average load to peak load (load factor) for the nation has been running about 65%. For some southern systems the load factor grows worse—lower—with each year as summertime air-conditioning load soars, so their peak-load problem becomes increasingly important. Northern utilities mostly get two annual peaks: (1) summer air conditioning and (2) early lighting demand in the winter imposed on industrial load.

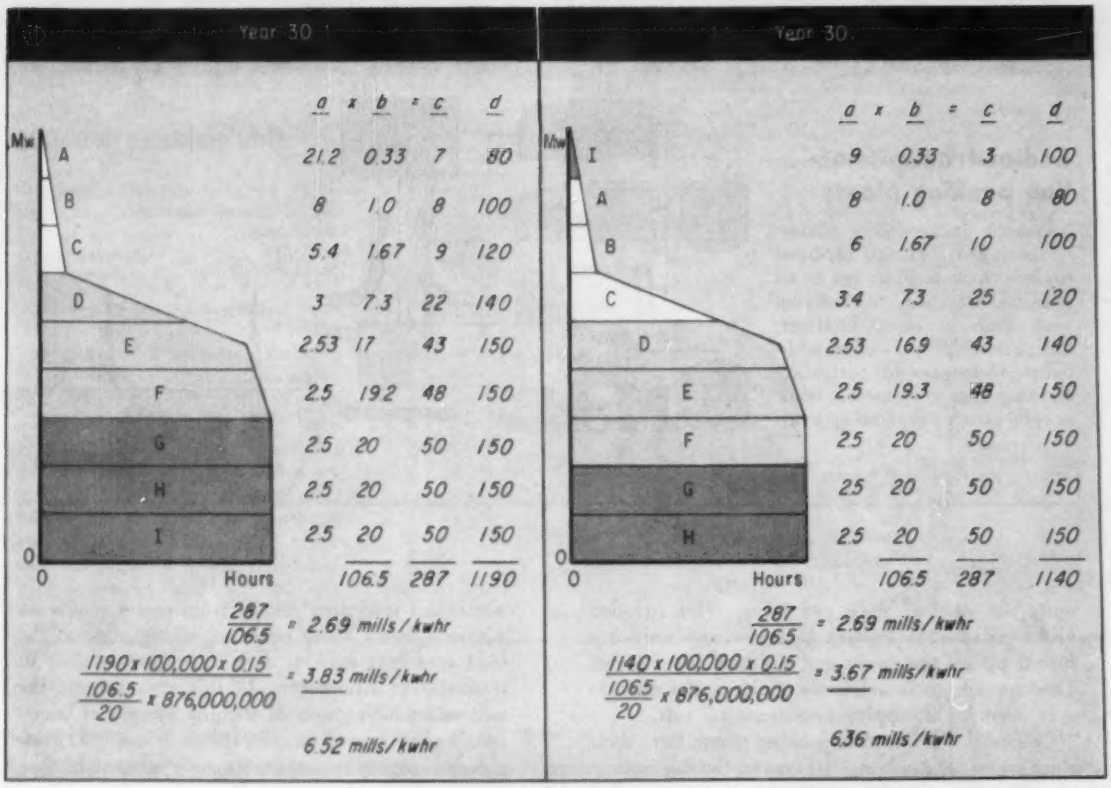
History. Up to the middle 50's studies on individual systems usually showed that the best way to provide additional capacity to meet the growing load was to install new high-efficiency units. They would take over the base of the load curve, push existing units higher on the curve so that the less-efficient older units fed the peak-load increment.

With a significant percentage of old, inefficient capacity on the system it was easy to prove in a new high-efficiency unit because of the saving in system fuel consumption.

After the rapid expansion of the past decades, many utilities now find themselves with an overall highly efficient generating plant. Now large fuel savings can no longer be made by transferring large blocks of load from the older to the newer units—usually they are of nearly the same efficiency level.

With this advantage vanishing it pays to look at the possibilities of putting in the cheapest capacity possible. Thermal efficiency ceases to be most important, giving way to operating flexibility, quick start-up features, reliability and low maintenance.

A hypothetical system will let us appreciate the interaction of economic factors in system expansion. Thumbnail study in the load-duration curves, above, assumes a system made up of 100-mw units, same size units being added as system load grows. The system-load factor stays constant in the years 10, 20 and 30, with loads at given accumulated hours all growing at the same percentage rate. In the year 10 we have three units on the system (no reserve capacity in any of the years). Unit A needs to run only 10% of the time, Unit C runs at full load all the time. Opposite each unit-output area we list the average unit fuel cost in mills per kwhr,



relative annual output, relative annual fuel cost and unit installed cost in $ per kw. Adding up the last three columns we get totals for the year.

For Year 10 we have an average system fuel cost of 3.38 mills per kwhr and an average capital-charge cost of 10.27 mills per kwhr for a total of 13.65 mills per kwhr. Capital charge rate is 15% annually. Unit A is inefficient by present standards, but it was installed at a time when equipment cost was low—$80 per kw. B and C are more-modern units but more equipment and inflationary trends upped their costs to $100 and $120 per kw. Average system investment is $300/3 = $100 per kw.

In Year 20, load and total output have doubled and three new units D, E and F have been added. They are more efficient than unit C but they cost more to install—$140 and $150 per kw. Older A, B and C now generate only 34% of the output they produced in Year 10. Year 20 system fuel cost has dropped to 2.77 mills per kwhr and the capital cost to 3.57 mills per kwhr to make 6.34 mills per kwhr.

In Year 30 system load and output has grown to three times that of Year 10. In the first example of Year 30, three new high-efficiency units, G, H and I, have been installed. They take over the base of the new load curve, making the equally efficient units D, E and F take over the intermediate loads, and putting old units A, B and C solely on peak duty. Average system fuel cost has dropped to 2.69 mills per kwhr, but average system capital cost has risen from 3.57 to 3.83 mills per kwhr, raising the total system cost from 6.34 to 6.52 mills per kwhr. Here capital costs overbalance the gain in fuel economy. In Year 20 average installed cost was 740/6 = $123 per kw; in Year 30 the cost is 1190/9 = $132 per kw.

In the last example, above right, we assume a different scheme of unit additions. Here G and H are efficient base-load units and I is a peak-load unit costing only $100 per kw. Its efficiency is better than the old unit, A, but markedly lower than units D to H. For this plan we find the overall fuel cost is the same—2.69 mills per kwhr—as in the first plan, but capital cost has dropped to 3.67 mills per kwhr, a significant saving over the first plan. Total system cost is now 6.36 mills per kwhr. Average installed cost has dropped to 1140/9 = $127 per kw.

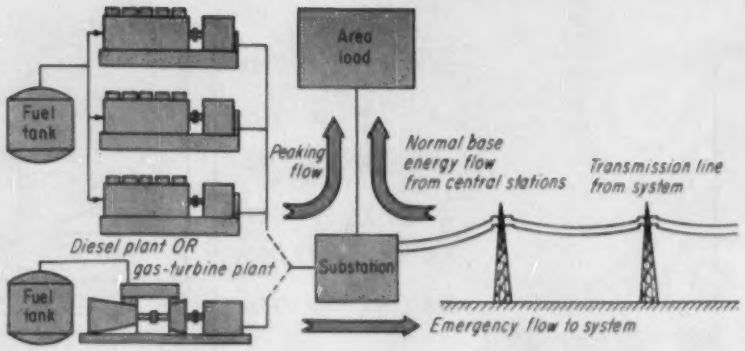
An interesting comparison is the overall production cost of any of the units E to H when run at full load all year:

$$\text{Unit cost} = \text{capital cost} + \text{fuel cost}$$
$$= \frac{150 \times 100{,}000 \times 0.15}{876{,}000{,}000} + 2.5 = 5.07 \text{ mills/kwhr}$$

Notice that adding these units from Year 20 to Year 30 increases the system average cost from 6.34 to 6.52 mills per kwhr even though the new

End-of-transmission-line peaking plants

Automatic unattended or remotely controlled operation of diesel engines or gas turbines can be an economic solution to carrying peak loads of short durations. Compactness of units offers additional advantages of portability allowing them to be used at other sites on growing regional systems.



units run at 5.07 mills per kwhr. This paradox arises because the existing high-efficiency units are forced up on the curve and produce fewer kwhr. This spreads their relatively high capital charges over fewer kwhr, upping system capital cost.

Clearly this shows that peaking plants have their place on modern systems. Of course, the full method of making a complete system analysis considers many other factors as well. For complete methods see pp 657-665 in *Power Station Engineering and Economy*, by Skrotzki and Vopat, McGraw-Hill Book Co (1960).

Peak-load plants do varied duty

Primary function of peak-load plants supplies energy to meet the short-time peak demand on a system. They may operate about four hours a day for two months during the peak seasons. Ideally, they should consume no fuel when they are off the line between peaks on successive days.

For this highly intermittent service they must have operating flexibility, allowing quick warmup and assumption of load in a matter of minutes. Complete automation in remote locations may be desirable; minimum operating labor is a must, or the economics of peaking becomes a loss. Despite sharp runups and rundowns in load, these units should need little maintenance if they're to pay off.

Because of these operating features, peak-load plants are naturals for emergency standby. Quick starting and loading from cold shutdown make them available on short notice to re-establish hot reserves on a system after a forced outage of a highly efficient unit. Peak-load units also carry load or stand by on hot reserve while main units go out of service for overhaul. For these side uses, moderate efficiency in a peak-load unit may be an asset.

In regional systems, low-cost peaking units may offer special advantages in reducing transmission line as well as generating-capacity investment. If a compact load area remote from power plants on a system has a sharp peak, a peaking plant at the load area may save or defer bigger investment in transmission equipment. In this arrangement the unit offers advantages of standby in case of transmission-line as well as central-station outage. Portable peaking units may be specially attractive: they can shift around as needed on a growing system.

Consider all types of peaking plants

The variety of plants available and proposed gives the system designer many alternate tools to solve his peaking problem. All types should be considered carefully when laying plans for system expansion.

Portable diesel plants are probably the first form actively promoted for peaking service. They are available in relatively small capacities—the largest group of engines offered, made up of five units, has 10-mw capacity. Larger stations can be assembled by adding engines as needed. The stations can be automated or remotely controlled at no great cost. No operating attendant is needed.

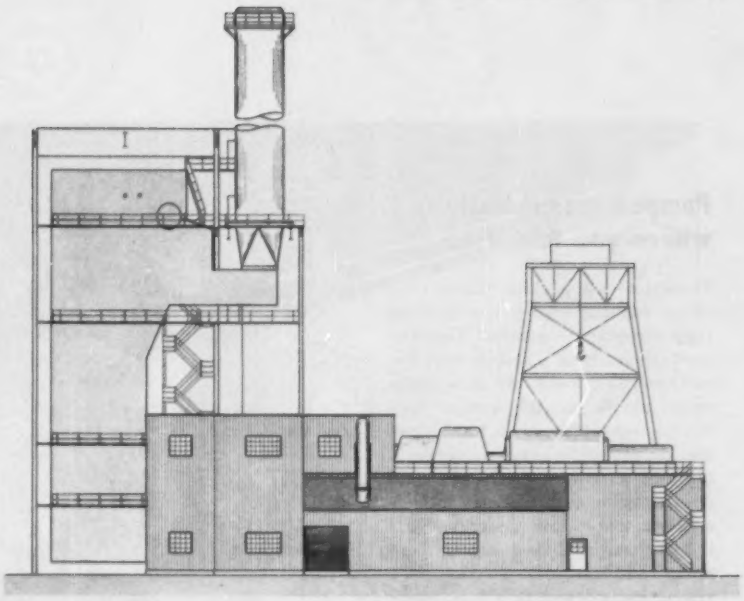
Open-cycle gas turbines have the same advantages as the diesel engine for many installations. They can be and have been built in portable form. Gas-turbine units are available in capacities up to and above 30 mw. They also are easily automated or remotely controlled. Gas turbines will run on a wide variety of fuels, but gas and oil would probably be most convenient for unattended operation.

Peaking steam plants have been given serious consideration; some are now under construction. An example of this type is the 100-mw unit scheduled for 1962 start in the E F Barrett Station of New York's Long Island Lighting Company, above.

Last-stage blading of the turbine uses all the capacity of the frame size. This limit may be much higher for intermittent peaking service than for a conventional turbine. Supplying cooler hydrogen allows higher loading on the generator.

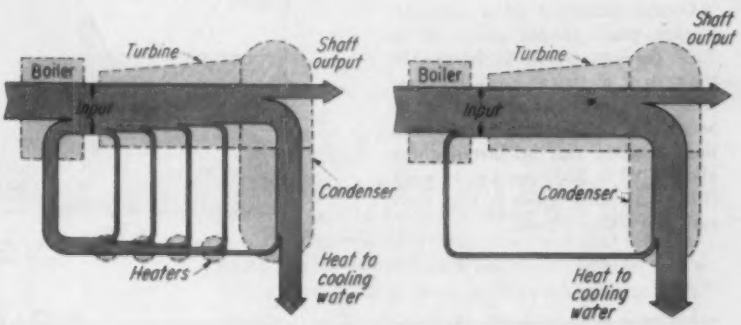
100-mw peaking unit

Compact unit uses 850-psig 900-F steam, one feedwater heater to 250 F, and no boiler air heater. Unit needs only two operators and has removable siding for maintenance access. Generator is designed for 0.95 pf and 0.5 short-circuit ratio. The 25,000-sq-ft condenser holds 3- to 3.5-in.-Hg wintertime backpressure; about 6-in. Hg in the summer when turbine loses only 4- to 5-mw capacity. Boiler-feed, condensate and circulating-water pumps are single full-capacity units. Feedwater heater has no bypasses or control valves. Design eliminates all excess capacity margins in main and auxiliary equipment.



Shutting off heaters raises turbine output

For ample turbine steam passages and excess boiler steaming capacity, output can be raised by shutting off several feedwater heaters. This may boost output as much as 10%. Method lets you carry short-time peaks at reduced efficiency for $50-per-kw increment investment.



Boiler costs are held down by: (1) high furnace heat release (2) no air heater (3) oil fuel (4) pressurized furnace (5) single f-d fan (6) no i-d fan and (7) no dust collector. Steam-coil heaters will preheat combustion air during winter startups. Stack temperature may go as high as 800 F.

The peaking unit has no new auxiliary-power transformer of its own, uses an existing transformer in the station. The unit has fused, magnetic across-the-line starters for the 4-kv switchgear and single controls for all motors from the switchgear of the 480-v motor control center in the operating area.

Expected cost: about $114 per kw, excluding step-up transmission facilities but including all company overhead charges. In comparison, a conventional reheat unit for 1962 start of 185-mw capacity would cost about $173 per kw; for 115-mw capacity it would run up to about $191 per kw.

Peaking capacity in base units is another possibility. Conventional turbine units can be built with excess capacity to run at lower thermal efficiency when producing in the overload range. Most units normally have some design allowances in their construction to assure meeting guarantees. Don't tap this excess margin without consent of the builder to avoid violating guarantee conditions. But the builder may consent if he finds peaking service won't exceed the normal stresses for which his unit was designed.

Turbines may be built to accept higher steam flows by raising throttle pressure and lowering temperature. Extra capacity on the order of 5% might be obtained at a cost of about $60 per kw—this includes extra capacity in both generator and boiler.

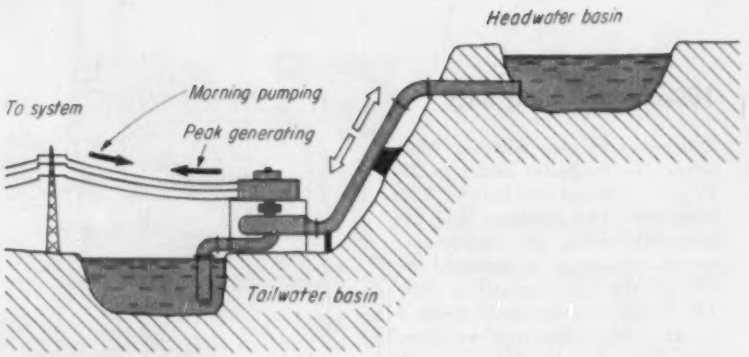
Re-establishing an old practice, the front end of a turbine can be partly or totally bypassed by admitting much more steam to lower turbine stages. Extra capacity can be bought for about $70 per kw when bypassing about 10% of the steam, about $95 per kw bypassing 50% steam.

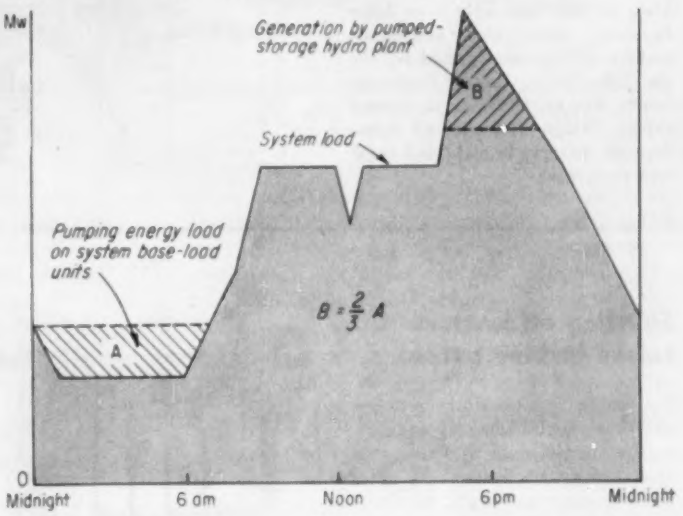
continued

Pumped-storage site is where you find it

These low-cost peaking plants offer cheap capacity—when you find the right topographic features. They run most efficiently in a system with low early-morning loads. At these times other plants on the system feed electric energy to pump water from the storage plant's tail-water basin to fill its headwater basin. In modern plants the electrical element acts as both motor and generator and the mechanical element acts as both pump and turbine. During peak system loads, water falls from headwater to tailwater, passes through turbine and generates electric energy to help carry the peak demand.

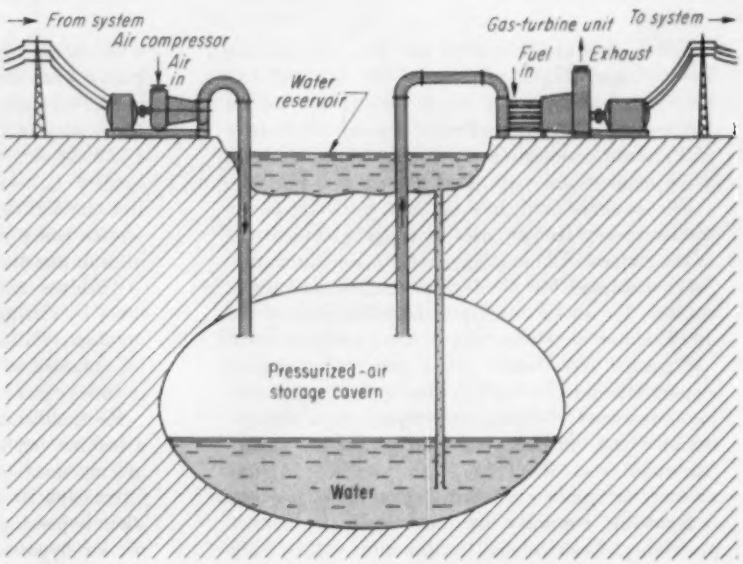
Overall efficiency of a pumped-storage plant ranges about 60 to 70%. Energy is lost to friction in the system, electrical losses in transmission, evaporation of water in the headwater basin. In favorable locations a plant can be installed for about $100 to $200 per kw, to work either with other hydro or with thermal generating plants.

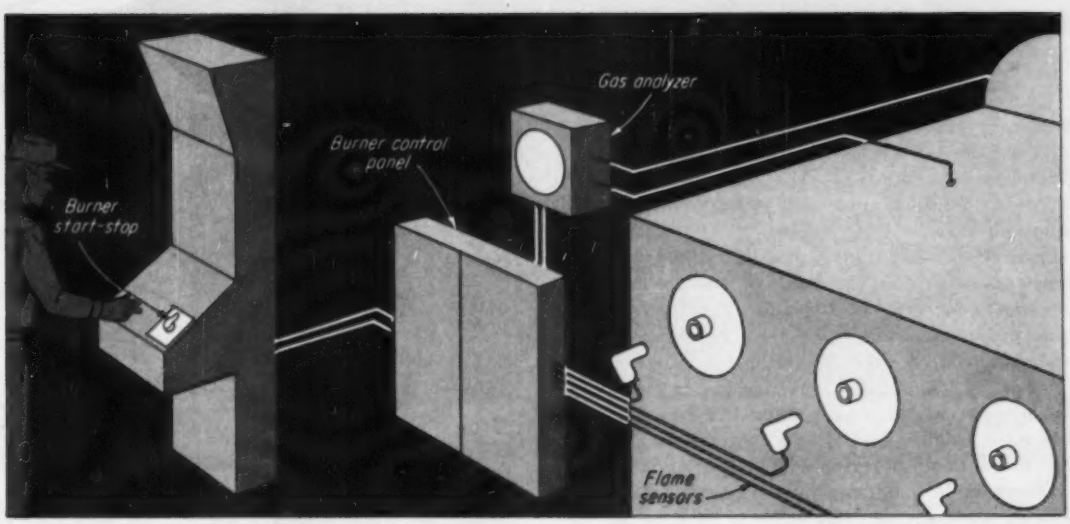




Air-storage peaking gas-turbine plant

Storing energy as pressurized air for carrying peak system demands has been suggested several times but up to now has not proved in commercially. Feasibility depends on finding a natural cavern, an abandoned deep-shaft mine or a depleted gas field that can hold pressurized air without leakage. A large supply of water and reservoir must also be available to keep the air pressurized. A motor-driven air compressor, smaller than needed by conventional gas-turbine generator, would run at its best speed during system low-load periods charging the air reservoir. During peaks the gas turbine draws air to generate.





AUTOMATIC BURNER CONTROL appears as building block in computer control or independent system on conventional units

Flame Monitoring ...important key to unit automation

With two fully automatic plants going into operation in the near future and several more already contracted for, manufacturers and utility engineers are deeply involved in development programs to refine controls required. Since ultimate justification of these systems stems from increased safety of operation, much of the development work has been in the field of safety monitoring. Most important of these safety monitors is the flame-failure monitor. Its importance stems from the terrific damage potential in boiler explosions and the difficulty of monitoring all causes of boiler explosions. High burning rates which go with today's high-capacity central-station units produce dangerous conditions which cannot be handled by an operator, no matter how well trained. Total time available for reaction to a dangerous condition is now down to a matter of 4 or 5 seconds.

Flame-failure systems have developed over the past 30 years to the point where their discrimination and dependability make them suitable for automatic burner control and interlock systems. Let's take a close look at these safety systems, the problems they solve as well as the ones left unsolved. You can also check your own plant requirements with those of utility plants incorporating automatic burner control in their next unit control systems.

Flame-monitor requirements are very exacting. Sensing equipment must be rugged and reliable, impervious to environmental attacks of heat, flyash, soot or fuel deposits. Electrical circuits must be designed so that deterioration of signals or circuitry does not affect operation. At the same time, sensing units must be capable of detecting flame at the burner monitored through the full-load range of that burner. Inability to do at least this much would lead to frequent nuisance shutdowns and probable bypassing by operators. Finally, sensors must be capable of sensing lost ignition or presence of hazardous conditions at the burner monitored, irrespective of outside interference from adjoining burners, glowing materials or reflections.

Flame sensors

Burner-safety requirements for central-station units are complicated by the great volumes of fuel handled in one unit and the physical impossibility of

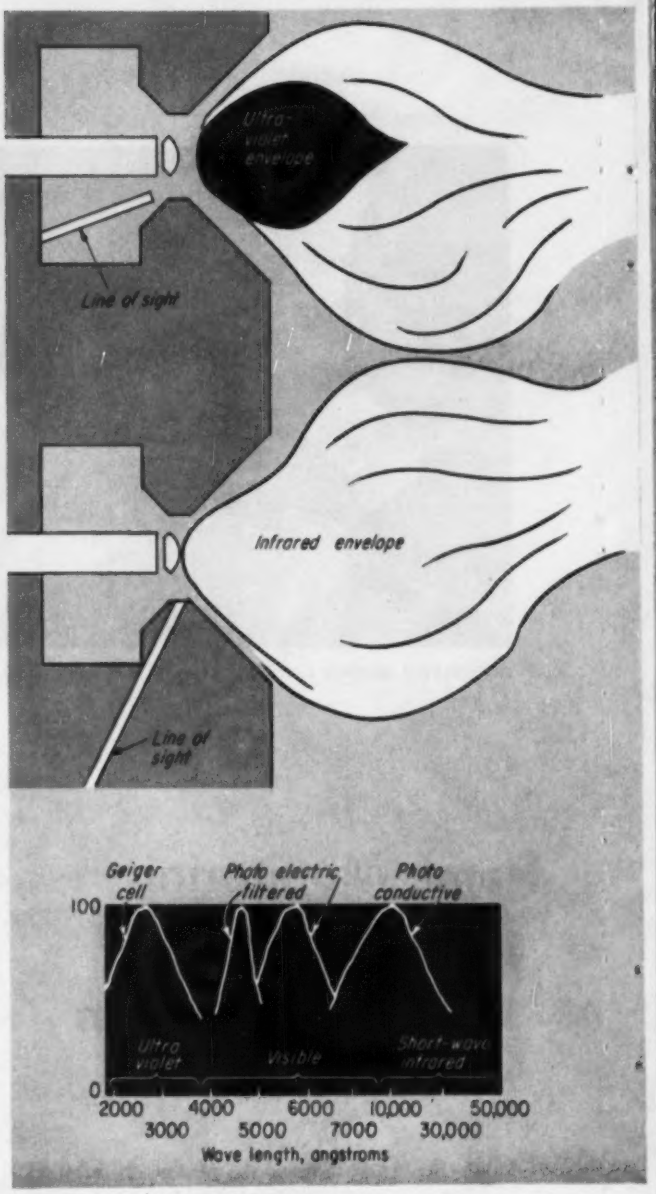
direct flame observation by the operator. From that point on, the basic problem is one of monitoring, either directly or indirectly, every possible combination of events which might lead to a boiler-furnace explosion.

Flame detectors currently fall into five groups: flame rods sensing flame ionization, pressure detectors sensing increased pressure drop resulting from flame propagation within a burner nozzle, photo-conductive cells sensitive to infrared light, photo-emissive and photo-voltaic cells sensitive to the full visible spectrum but usually filtered to sense only blue wave lengths, and Geiger type cells sensing only the ultra-violet region of the light spectrum.

Flame rods find limited use in central-station units since oil or coal firing tends to build up carbon deposits and ground rod. Flame rods must also be located in the zone where the flame is ionized in order to complete the electrical circuit. In this high-temperature area, the best heat-resistant alloys overheat and fail. However, flame rods do find extensive use as gas-lighter monitors.

Photo-conductive photo-emissive and photo-voltaic sensors operate in the upper light ranges of 3800 angstroms and above. Photo-conductive cells are most sensitive to infrared light in the range above 6500 angstroms. Combined with a special circuit, these cells are sensitive only to flickering infrared flame light. However, they are limited somewhat because they pick up the flicker of flame tails from other burners or the flicker of burner reflections on furnace walls. By sighting within the burner throat, extraneous flicker can be blanked out but the sharp angle may give problems with sighting tubes, etc.

Geiger cells are sensitive to light in the range below 3000 angstroms. Properly designed units may be capable of operating below 2000 A. Experience with these cells on central-station units is limited but they seem to possess good coal-, oil- and gas-flame discrimination. In development work, these cells indicated erratic flame caused by a dirty oil atomizer.

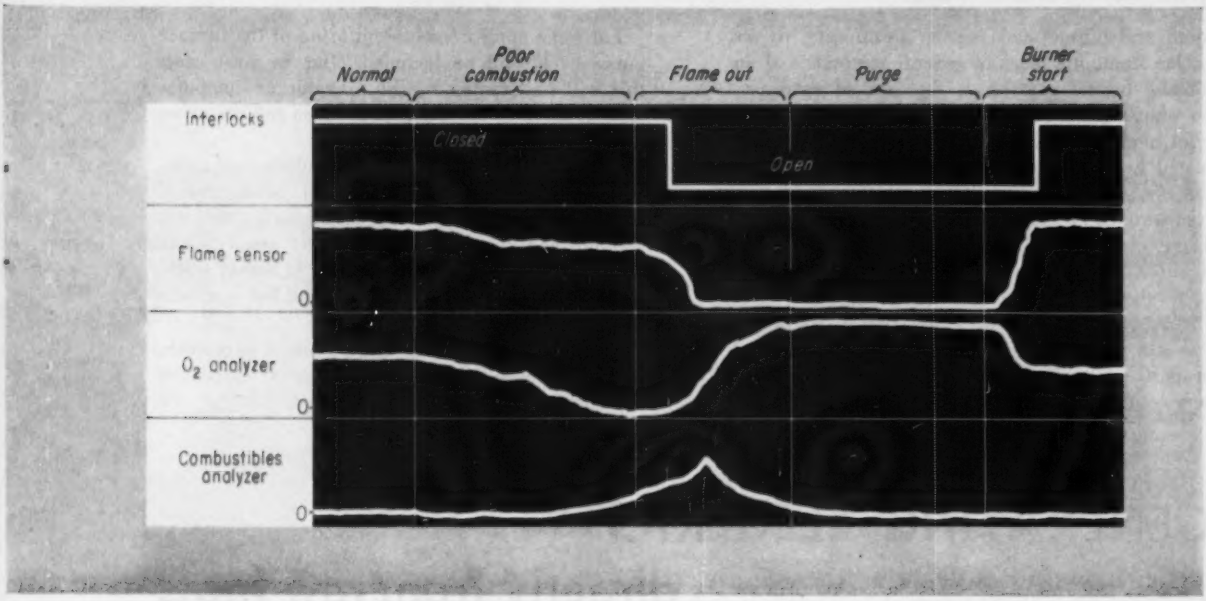


FLAME DISCRIMINATION depends upon sighting angle, sensitivity to portions of light spectrum of various fuels

Flue-gas analyzers

Flame-failure sensors are an important part of boiler-safety systems. But to complete the protection of the unit, operators require some warning of explosive-mixture buildup. Recently, several explosions involved improper combustion or other situations which allowed combustibles to build up in the units. Flame sensors, then, are appearing as important parts of unit safety but they are being supplemented by gas analyzers. Charts, above, show reactions of several safety devices to hazardous conditions in a large unit. Prime advantage of gas analyzers lies in their anticipatory action. By warning operators early enough to take corrective action, trip outs may be prevented.

Combustibles analyzers are suggested as a check on gas buildup in the boiler furnace or gas passes. With this equipment, gradual buildup of



SYSTEM REACTION to changing combustion conditions indicates need for complete, integrated burner control. Flame detector monitors main cause of explosions—flameout. Gas analyzers warn of explosive buildup in time for correction

explosive gases can be detected and purge cycles can be terminated according to readings from several points in the unit. Combustibles analyzers also serve to warn operators of poor combustion even if explosive conditions never are attained. Recent suggestions for using these analyzers called for operator warning when 0.3% combustibles were recorded and interlocked trip when 1% combustibles were recorded for 5 minutes, 2% combustibles were recorded for 30 seconds or if a value of 3% was reached. These percentages are well below the lower limit of explosive mixtures at room temperature, usually taken as 6% for oil and coal and 4.8% for natural gas. At the same time they are sufficiently high so that an excessive number of false trips should not occur.

O_2 analyzers may serve a somewhat different purpose in gas sampling. Where the combustibles monitor would detect gas before an explosive mixture occurred, the O_2 analyzer would detect a change in excess air before any combustibles were accumulated. Since the O_2 analyzer's chief use is as a monitor of combustion efficiency and burner balance, it usually draws its gas sample from the main furnace or directly at the burners. (For one example of this application, see April POWER, p 92, United Illuminating Co's use of O_2 for burner control). O_2 analysis does not replace combustibles monitoring. But it supplements the other safety devices by indicating burner conditions before unsafe operations occur. With high-volume samplers, O_2 analyzers can detect flame failure almost as fast as conventional flame sensors, thus giving a backup alarm to operators. For more on gas analyzers' warning of hazardous mixtures, see POWER's TD report on safety monitoring, July 1959, p 55.

Dependability of any safety-system element is a prime consideration. Within the past few years, gas analyzers and their accompanying sampling probes, etc, have indicated high degrees of dependability in combustion-control systems. As a result, central-station-safety systems now may include this equipment with no anticipation of increased maintenance or nuisance shutdowns.

Complete systems

Automatic burner startup and shutdown is part and parcel of the several fully automatic plants currently in the planning stages. In addition to those plants making the jump to fully automatic operation, several units will have automatic burner control. These more conventional plants will help prove out the effectiveness and dependability of the control package. Fully automatic burner controls come at the end of several years of research and development by burner and control manufacturers. One model, currently planned for installation on a gas- and oil-fired unit, features a solid-state electrical-sequencing control system applied to a gas ignition

torch and burner and register positioning drives.

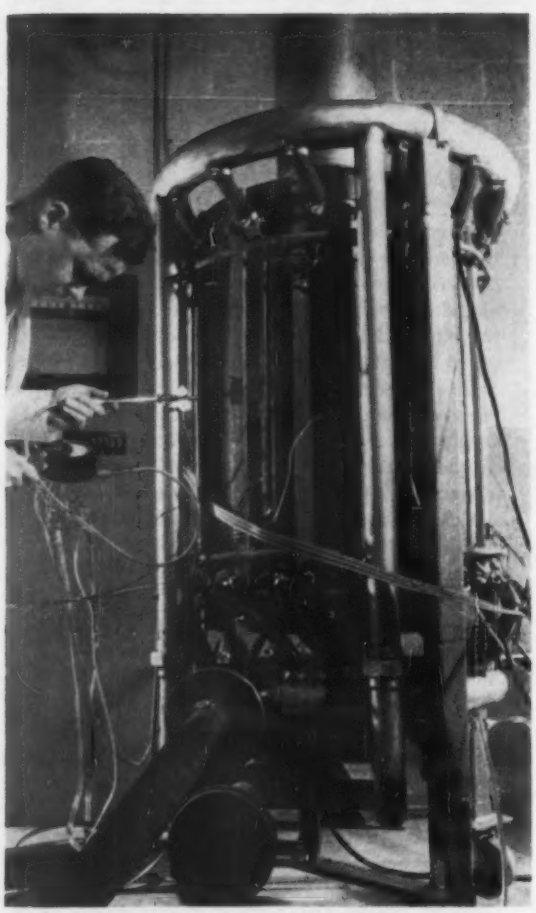
One stumbling block to general acceptance of automatic burner controls is the lack of agreement on what the control should or should not do. The pilot model described above is designed to be actuated by the operator or by computer control. In the operation sequence, permissive checks by the control must be completed to put burner in service. These checks include six conditions: (1) flame monitor is in service and not seeing flame (2) fuel valves to lighter and main burner are closed (3) fuel and air pressures are correct for lightoff (4) air register is closed (5) fuel burner tip is properly positioned (6) combustibles analyzer reads zero combustibles.

For some applications, monitoring of the furnace purge cycle will be included. But in most cases this will be handled by the operator or computer since it involves operation of the fans and the measurement of air flow.

As this equipment applies to multiburner units, the trip function may or may not be automatic. Since most explosions occur below half load, one solution calls for burner trip if the flame failure occurs below half load on the unit. At higher loads, flame failure would warn operators but not take the burner out of service.

Future use depends upon operation of pilot units, and to an even greater degree, general agreement on what safety controls must control.

GENERATING ELECTRICITY ...directly from raw fuels



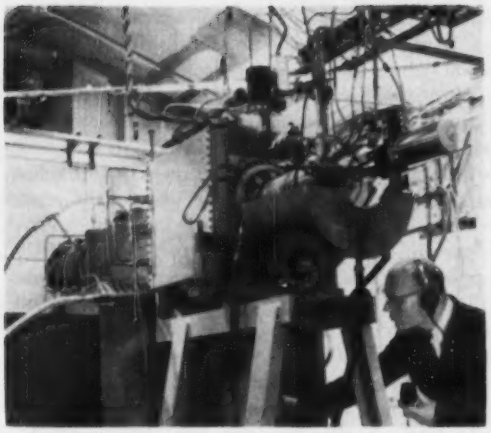
THERMOELECTRIC GENERATOR burns kerosene to produce total of 2.5-kw direct current at voltages from 10 to 120, depending on how modules are connected together. Furnace runs at 1200 F, with elements watercooled to 50 F

Military needs for power generation have triggered strong research efforts to develop quiet, lightweight, efficient generating units. Most of the principles being developed are not new, but new knowledge and new materials make them more attractive—and in some cases feasible.

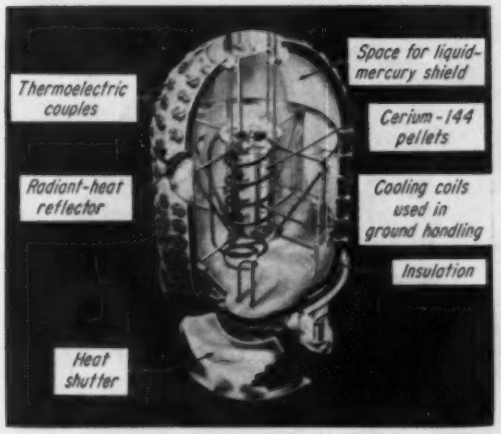
Like many developments in the power field, it is highly unlikely that they will supersede present efficient plants, but they will probably find their own niche where they have the most advantages to offer. Alert to potential advances in generating practices, the electric utilities follow these developments with great interest. Builders of present forms of power plants have not been idle; we find improved "conventional" equipment offered with the passing years—this will be the pattern for the future. So designers of conventional equipment need not despair that their work will soon be obsolete. Now, let's look at some of the new equipment developing in our labs.

Thermoelectric generators. Photo, left, shows the largest thermoelectric unit built to date, a Westinghouse Laboratory development. This suggests the shape of things to come. An extension of the old principle of the thermocouple teamed up with new alloy materials and semiconductors makes possible generation of electricity directly from heat at a respectable thermal efficiency. Photo on facing page, upper right, shows a special application of thermoelectric generation for space-satellite auxiliary power supply built by the Martin Nuclear Division. Radioactive material supplies raw heat energy for conversion to electricity.

Thermionic generator, right, uses the well-



Magnetohydrodynamic generator



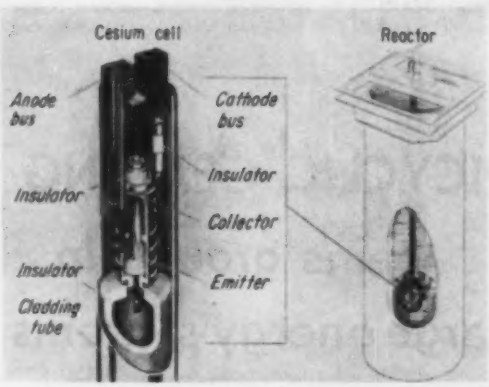
Radiation-powered thermoelectric unit

known Edison Effect to produce electricity. An emitter wrapped around a fully enriched uranium fuel element heats when the cell is inserted in a nuclear-reactor core. The emitter throws out electrons to be caught by the water-cooled collector. In this General Dynamics cell, cesium gas neutralizes the space charge of the electrons to pass a current.

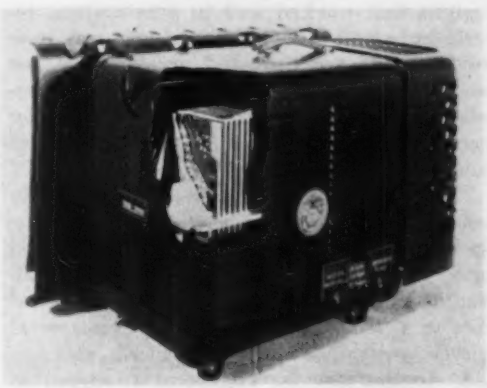
Magnetohydrodynamics, above, offers intriguing possibilities—*if* the high-temperature-materials problem can ever be solved. Here a hot ionized gas at about 5000 F and under several atmospheres pressure, speeds between two electrodes in a magnetic field to produce electricity directly. Remaining energy in the 2000- to 3000-F gas is sopped up by a conventional generating plant. Westinghouse Laboratories was the first to build a unit, burning oil, that ran for more than four minutes and produced a few kw of electricity.

Fuel cells, lower right, run at temperatures varying from ambient to thousands of degrees. Chemically reacting fuels, hydrogen, carbon, hydrocarbons and oxygen power the cell to produce electricity. Various cells answer to these names: *Hydrox*—low- or intermediate-temperature hydrogen-burning cell; *Redox*—reduction and oxidation processes take place in intermediate substances, then pass over inert electrodes; *Molten salt*—high-temperature salts for electrolytes; *Carbox*—high-temperature carbon-oxygen system. The ion-exchange-membrane hydrox cell by General Electric Company, lower right, produces 200 w at 24-v dc. Gas canister holds enough fuel to run the unit for 14 hours.

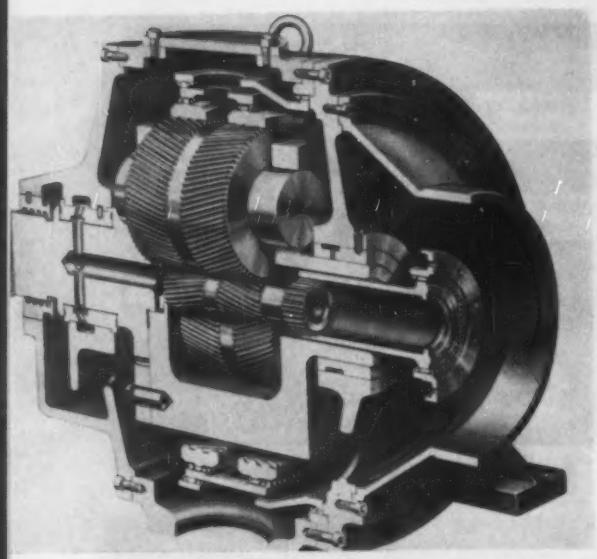
Solar cells, low-power-dc producers, use semiconductors as their principal material. They've worked well in feeding small energy demands.



Nuclear-powered thermionic cell



Gas-powered fuel cell for field use



ORBIT GEARS mount in toothed carriers, sun gear is supported by planets only for equal planet-gear tooth loading

EPICYCLIC GEARING

. . . gains ground in large energy systems

Epicylic gearing—planetary, star and solar—has been with us a long time. Simple, rigid designs that worked well in gear-motors, bicycle hubs and Model-T Fords gave way over the years to sophisticated arrangments for modern automotive and aircraft power transmissions. Extremely large epicyclic gears for marine propulsion climb to 50,000 hp with speed ratios of 5.2:1.

These heavy-duty gears necessarily have to be designed so each planet gear shares the load equally. Up to now, most gears had "floating" orbits and lightly restrained sun gears to insure equal planet-gear-tooth loading. But this feature often increased costs to a point where the special advantages of epicyclic gears could not be economically obtained.

A floating-gear arrangement developed in Europe and patented by W G Stoeckicht is now manufactured in the U.S. by the DeLaval Steam Turbine Company. It may well compete with normal parallel-shaft gearing and still give all the inherent advantages of epicyclic gearing.

The Stoeckicht gear provides internal flexibility or float, using special mounting for both orbit and sun gears. Orbit or "ring" gears are fastened, depending on gear type, to case or shaft through a series of toothed carriers which permit the gears to float. Snap rings limit travel between carriers to prevent disengagement. Planet gears themselves support the sun gear—no bearings—so sun gear will load the planet-gear teeth equally. Connection between sun gear and high-speed shaft of driver or driven equipment is also flexible, preventing externally loading the sun gear which might interfere with freedom of adjustment.

To date in Europe there are over 2200 Stoeckicht-gear installations. Hp goes as high as 19,000. In the U.S. 19 of these gears have been applied for a wide variety of jobs—turbine-generator, boiler-feed-pump and centrifugal-compressor drives. First epicyclics as boiler-feed-pump speed increasers are going into operation at Public Service Electric and Gas Company's new Mercer Generating Station in New Jersey. Many more are being built for other uses including a vertical arrangement for condenser circulating pumps. Here the inclusion of a speed-reducing gear permitted a less-expensive high-speed motor.

Let's look at advantages and disadvantages of epicyclic gears for general industrial applications, see what they mean in terms of operation and maintenance. Table, above right, directly compares epicyclic and precision parallel-shaft gears for a specific 6000-hp job. Compare lb-per-hp (1.25 for epicyclic vs 2.58 for parallel shaft). Gear-loss reduction reflects increased efficiency. Basic gear takes less space, and still more space is saved because the epicyclic needs no offset. Higher k factor and multiple power paths in epicyclic design largely account for these differences; k factors in both instances reflect good modern design.

In-line shafts inherent in epicyclic gearing can be a great help to equipment designers. This feature at the Mercer Generating Station allowed minimum boiler-feed-pump height and at the same time avoided the awkward horizontal offset required by parallel-shaft gears. Reduced space and weight requirements mean more-compact equipment arrangements—more dollars to the good. The lower requirements frequently let you shoehorn modern equipment into an existing plant.

Same sense of rotation in planetary gears adds design flexibility. Take a case where driven equipment is duplicate but drivers are opposite-hand. Using a planetary gear for one and same-ratio star gear for the other permits exact duplica-

Epicyclic vs parallel-shaft ratings for 6000 hp, 7.15:1 ratio

Ratings	Epicyclic gear	Double-helical parallel-shaft precision gear
Weight, lb	7500	15,000
Height, in.	51½	71
Length, in.	51	56
Width, in.	53	93
Offset, in.	none	35.475
Volume, cu ft	81	215
WR^2 of gear	2600	15,150
Losses, hp	110	130
Face width, in.	7.25	16
Oil capacity, gal	60	35
Pitch-line velocity, fps	140	326
k factor	295	101

tion of driven equipment—a saving in design and spare-parts requirements for driven equipment.

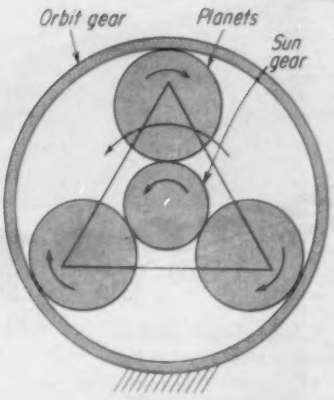
Reported reliability of Stoeckicht gears installed in Europe has been high. So far, the first gear installed in the U.S. (built in Germany) has run well over 25,000 hr with no maintenance. This particular speed reducer operates between a high-speed turbine and a low-speed 1200-kw generator (see POWER, Oct 1958, p 102 for plant story on the installation).

Question mark at the moment, of course, is maintenance of epicyclic gearing. Indicated reliability is good, but there is no doubt that the dismantling process is more complex than for parallel-shaft gears. There are more parts; they need more careful and skillful handling. Weights to be handled are less, but you can't completely inspect gear teeth without disassembling practically the whole works.

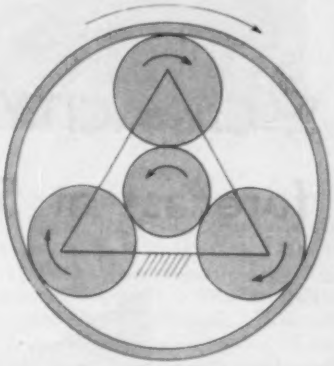
Tooth breakage is uncommon in any good gear design. But it does happen. In a parallel-shaft gear a broken tooth will usually fly free, but in an epicyclic gear it may entangle itself with other meshing teeth. Result is extensive damage to more though smaller parts. Another point to keep in mind: In epicyclic gears there are no shaft ends available for oil pumps, tachometers and power takeoffs.

Advantages of epicyclic gears are many—space, weight, in-line shafts, to name a few. Reliability factor seems high, but actual operation and maintenance records will be needed to fill in this picture.

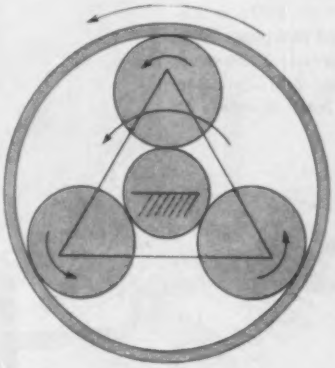
These are the three basics of epicyclic gearing



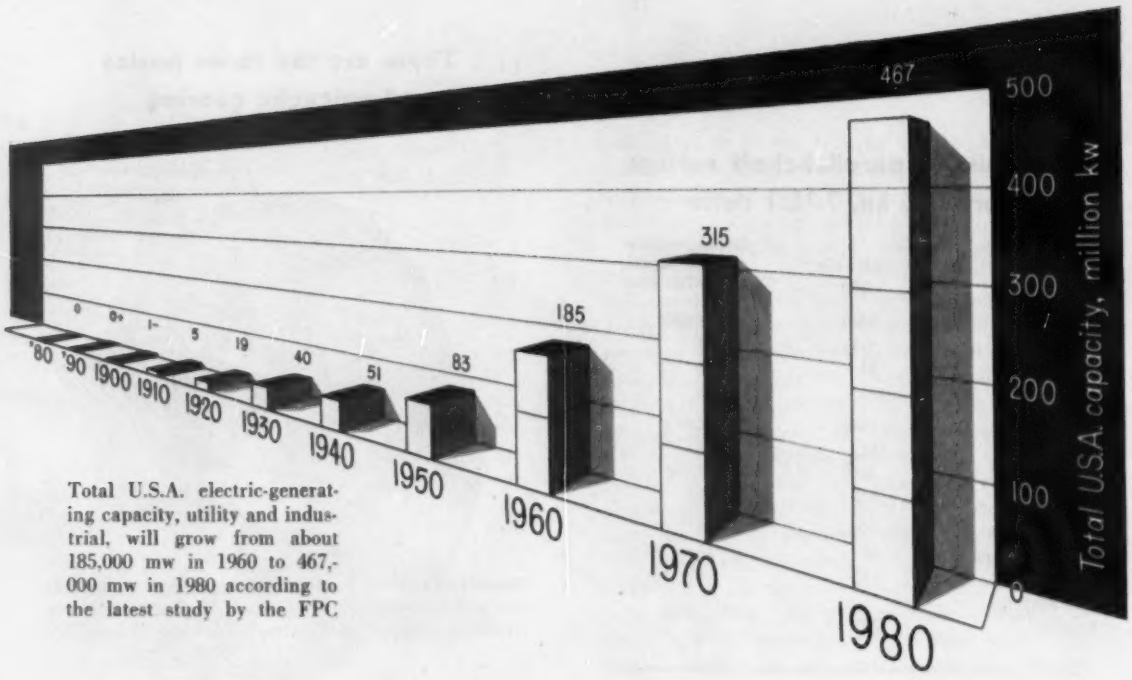
PLANETARY GEAR has fixed orbit gear. Low-speed planet carrier has same sense of rotation as high-speed sun gear. Available planetary gear ratios range from 3:1 to 12:1



STAR GEAR has fixed planet carrier but planets rotate. Low-speed orbit gear rotates in opposite sense to high-speed sun gear. Range of gear ratio is 2:1 to 11:1



SOLAR GEAR has fixed sun gear. Low-speed planet carrier rotates in same sense as high-speed orbit gear. Use is limited by narrow gear-ratio range—1.2:1 to 1.7:1

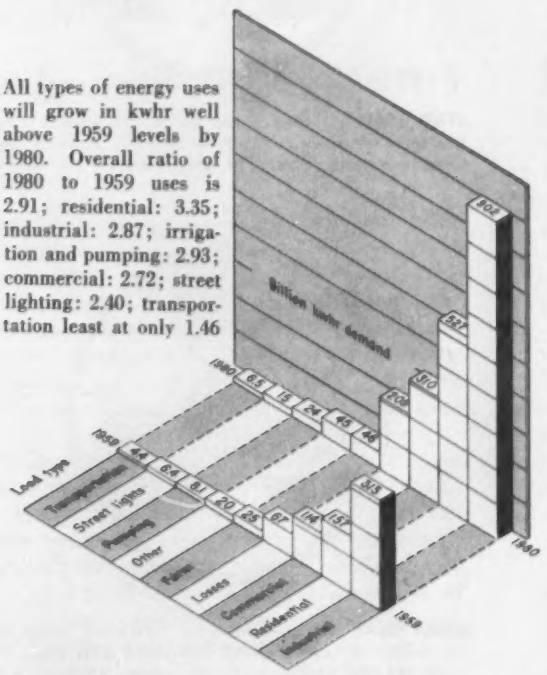


Total U.S.A. electric-generating capacity, utility and industrial, will grow from about 185,000 mw in 1960 to 467,000 mw in 1980 according to the latest study by the FPC

U. S. CAPACITY GROWTH

. . . forecast at 5% yearly

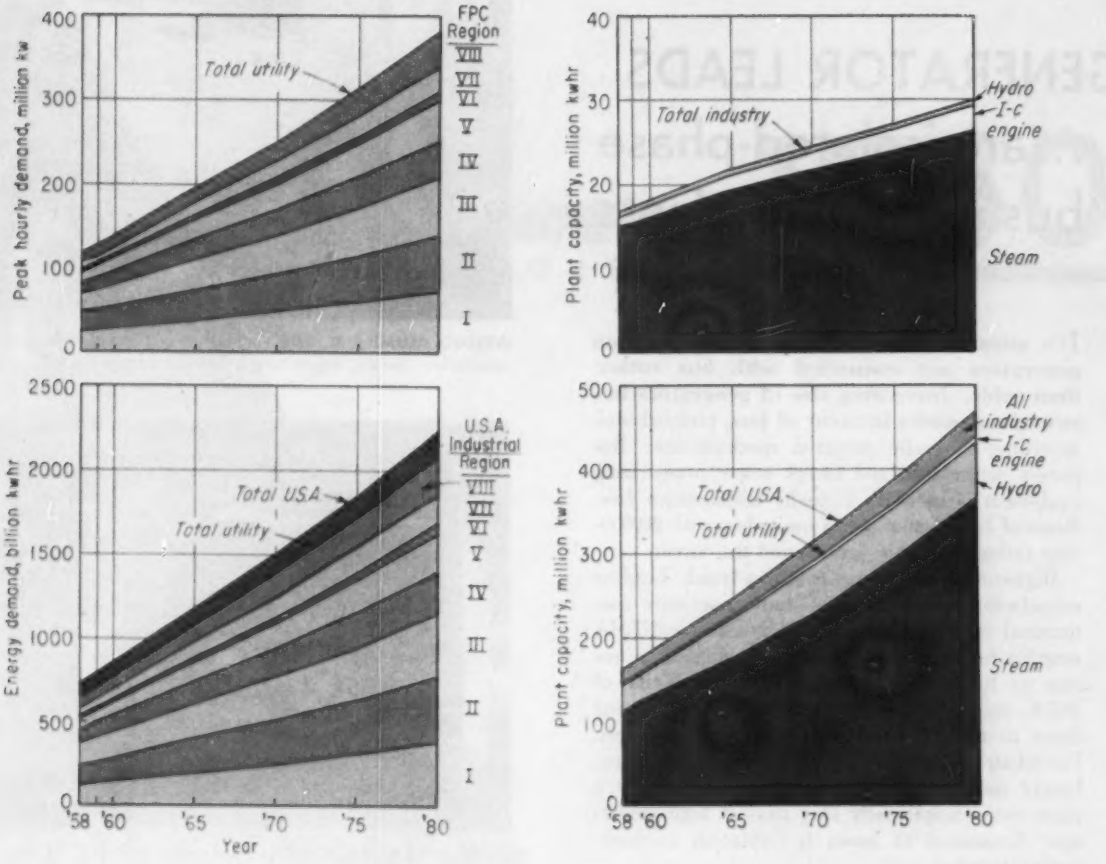
All types of energy uses will grow in kwhr well above 1959 levels by 1980. Overall ratio of 1980 to 1959 uses is 2.91; residential: 3.35; industrial: 2.87; irrigation and pumping: 2.93; commercial: 2.72; street lighting: 2.40; transportation least at only 1.46



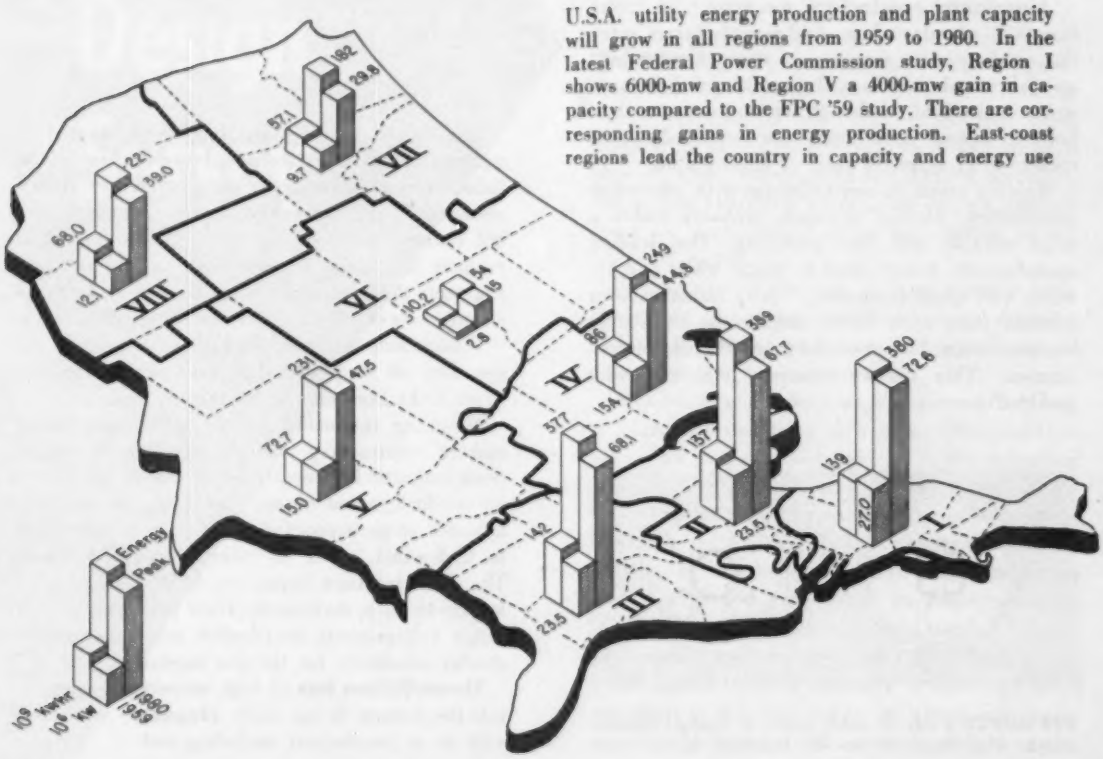
Despite recent lags in expansion activity latest Federal Power Commission study finds that predicted 1980 energy needs and capacities have grown since their June 1959 study. Graphs, above right, show yearly energy demands and capacities needed from 1958 to 1980 by regions.

Total energy production by utilities in 1980 is now predicted at 2,083,600-million kwhr or 2.08-trillion kwhr compared to about 770-billion kwhr expected in 1960. Total noncoincident peak is expected to reach 380-million kw in 1980. To meet this peak, total utility-plant capacity will be 437-million kw. Adding 30-million kw of industrial capacity brings the total to 467 million kw for the U.S.A. Tremendous growth in steam capacity of both utility and industrial systems will keep other forms at only a minor percentage of the total.

None of these figures include Hawaii or Alaska. Utility, military and industrial capacity for Alaska is estimated at 400 mw, for Hawaii at 500 mw, as of Dec 31, 1959. In Alaska, total utility capacity is expected to grow from 108 mw at the end of 1957 to 356 mw in 1980. Alaska's tremendous hydro potential could be used for rapid industrial growth.



U.S.A. utility energy production and plant capacity will grow in all regions from 1959 to 1980. In the latest Federal Power Commission study, Region I shows 6000-mw and Region V a 4000-mw gain in capacity compared to the FPC '59 study. There are corresponding gains in energy production. East-coast regions lead the country in capacity and energy use



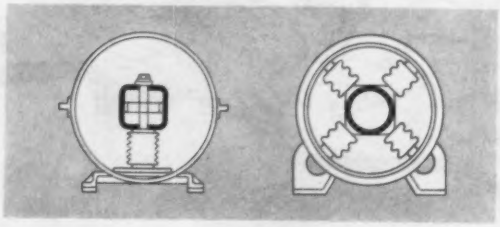
GENERATOR LEADS ...are isolated-phase bus in modern plants

It's estimated that 75% of central-station generators are connected with bus rather than cable. Increasing size of generators has swung economics in favor of bus, prefabricated according to easily prepared specifications. Bus proves dependable, and except where pressurizing equipment is used it's virtually maintenance free. Buses of 14,000 amp are in use today, with 20,000-amp ratings probably just around the corner.

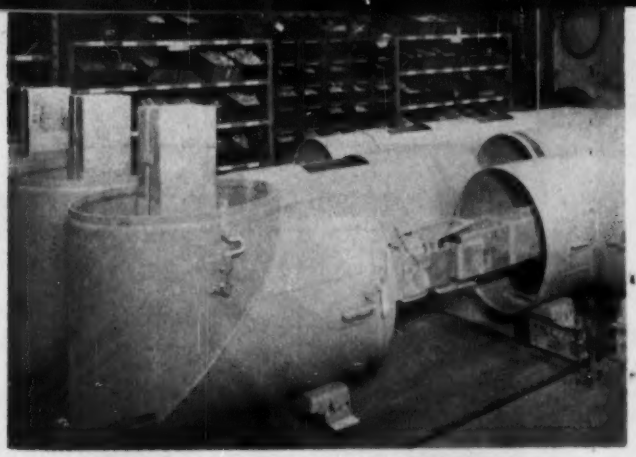
Higher-temperature bus is strong trend. Leading manufacturers advocate 65-C bus-temperature rise, terminal rise of 105 C. Rating is due for NEMA sanction for inorganic insulation. Reduction in bus size up to 15% is promised. Terminal rise of 105 C, acceptable on generator end, can be graded down to transformer to avoid transmitting heat. Forced-air cooling is in use in about a dozen plants. Liquid cooling of hollow conductors may have a place too—exceptionally long runs at high amperage. Economics of losses is limitation on high-temperature bus.

Aluminum conductors see service in better than 90% of today's bus. And manufacturers agree that welding is the way to join them. Connections are fabricated; welder only has to join rings or strips in the field. Although welding is faster than bolting, bolted connections are dependable—but makers can't agree on value of silver-plating.

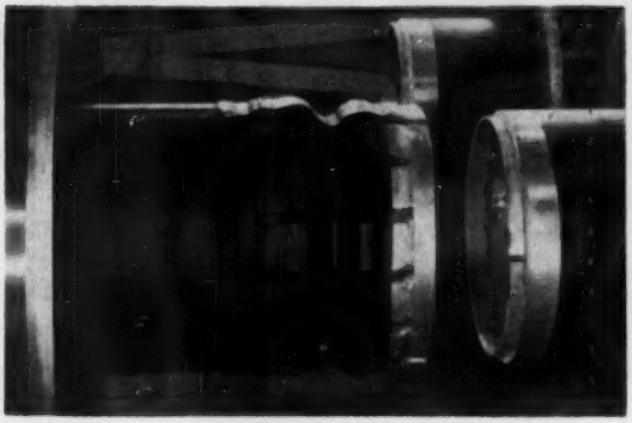
Welding covers is new technique with interesting possibilities. Method is faster, probably makes a more reliable seal than gasketing. One leading manufacturer welds metal to metal while another welds with epoxy compound. Epoxy insulates cover sections from each other, cutting the circulating currents induced by powerful magnetic field of conductors. This follows practice originated with gasketed covers.



BUS SUPPORTS may be either single- or multiple-insulator design. Short-circuit stresses are important in the design



WELDED ALUMINUM, both conductors and covers, makes installation simple, dependable. Bus may be pressurized



LAMINATED CONNECTOR is factory-welded to one end of conductor and prepared with a fitting ring for field welding

Argument for conducting weld: high circulating currents effectively suppress flux that might induce voltage in adjacent metal structure. Heavy aluminum plates are welded to end of ducts to permit current flow between them. It's too early to evaluate fully this method of flux suppression, and engineers don't agree on hazards of stray fields or effectiveness of other methods for dealing with them.

Pressurizing becomes practical with welded covers. Dry air supplied by an auxiliary blower and dryer looks like best gas for this purpose.

Mounting conductors inside duct is subject of makers' controversy. Under short-circuit conditions magnetic field exerts severe mechanical forces on conductors and covers. Advocates of resilient-mounted single support say conductor is better able to find exact center or minimum-force position. The four insulator types are built with rocking feature to allow movement. Their proponents claim better voltage-stress distribution and consequently shorter insulators for the bus supports.

De-excitation bus of high amperage is coming into the picture. It has many advantages associated with its ac counterpart, including cost.

Power
OCTOBER 1960

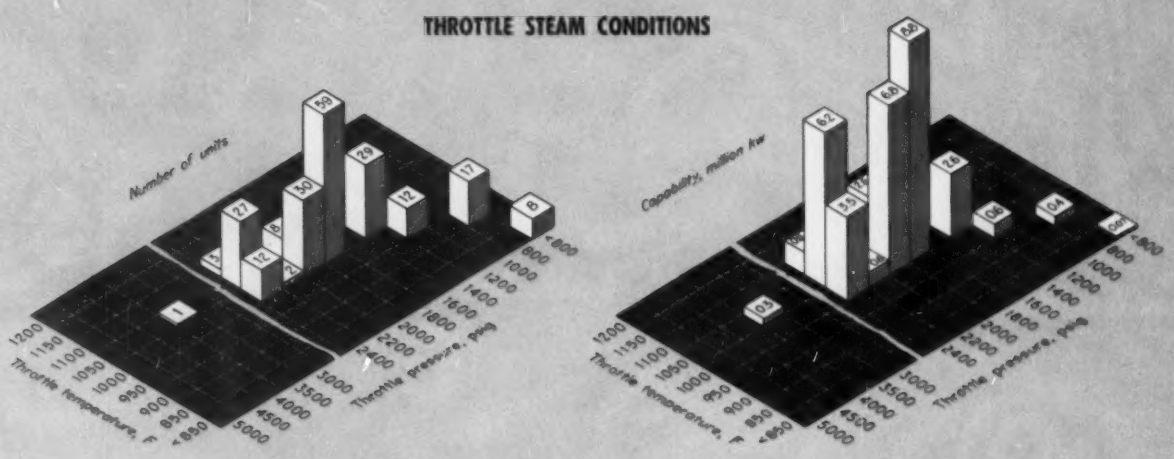
Central Station Design Survey

The following 11 pages carry tabulations of pertinent data on conventionally fueled and nuclear plants. Information listed for conventional steam plants is the most complete that can be had for units planned, under construction and starting operation. As in last October's survey, the design features listed for each project cover four tightly packed tabulated pages.

But, because of the way we must compile facts, the survey of conventional steam plants does not include *all* current programs, nor does it consist *only* of current plant construction.

This comes about since we are working from lists of planned installations as a base. Questionnaires asking for project details are sent to the individual companies on those lists. Data may appear in the tables well before construction starts; or if engineering is delayed, may appear long after announcement.

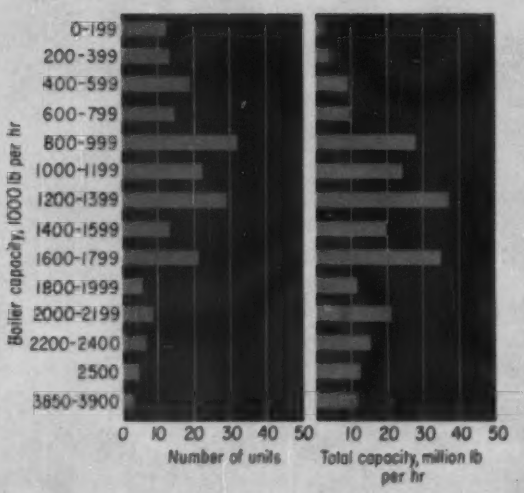
Being representative of design and construction in late 1959 and early 1960, the following tables give useful information on general trends. But you can readily see why they can't be complete. So just consider them as extensive samples and don't use them to get total values or where any degree of incompleteness would seriously distort results.



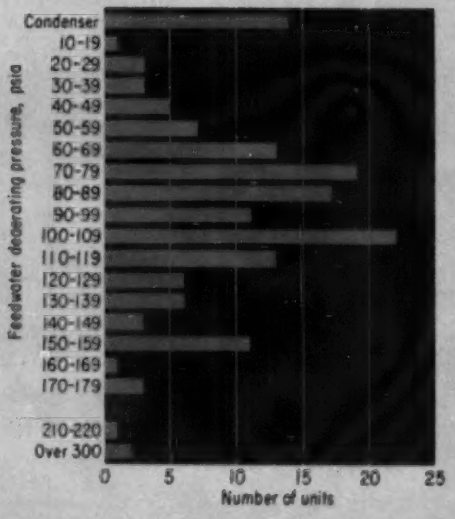
THROTTLE STEAM CONDITIONS of 2000 psig and higher are planned for almost 40% of the new units scheduled for 1960 and later

OVER 60% of new turbine capability starting in 1960 or later will use throttle steam at 2000 psig, 1000 F and higher

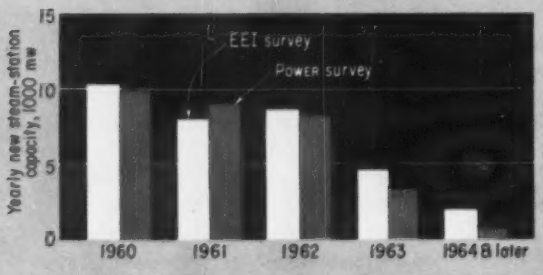
Trends in CENTRAL STATIONS



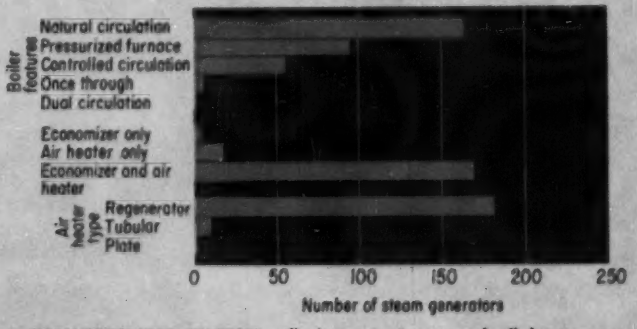
STEAM-GENERATOR RATINGS for 1960 and later show decrease in smaller units, but some levels as 1959 for most-popular capacities



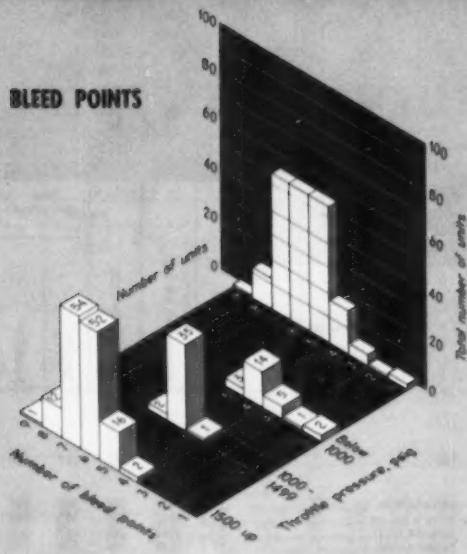
FEEDWATER DEAERATING pressures concentrate in the middle ranges (58% of units at 70 to 130 psia); about 9% use condenser only



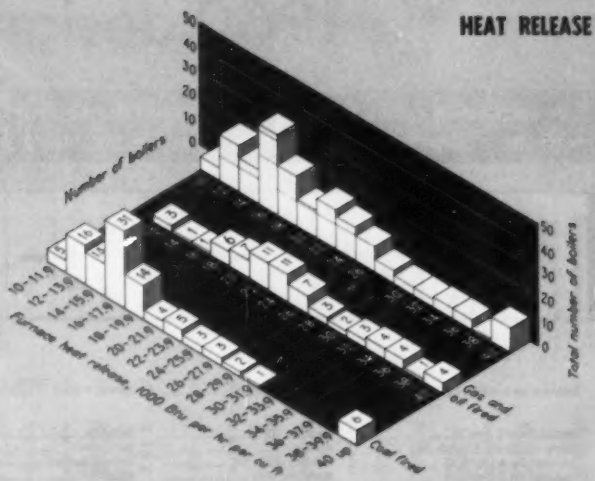
POWER SURVEYS in this and previous reports cover approximately 93% of 33.7-million-kw steam capability scheduled for 1960-1964



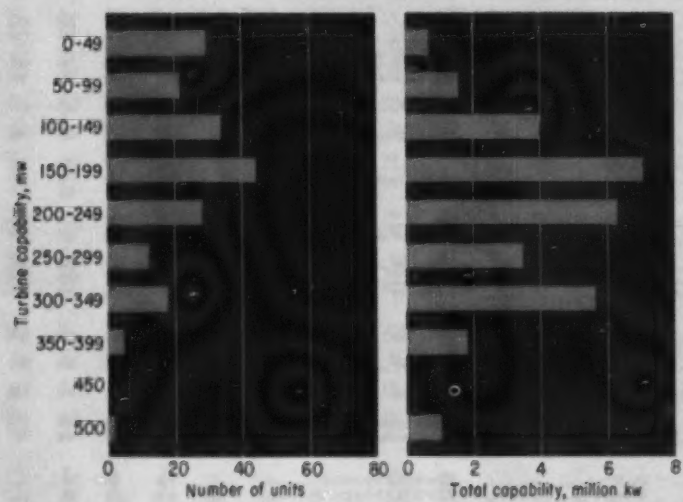
STEAM-GENERATOR FEATURES still show growing use of all heat-recovery units and continued popularity of pressurized furnaces



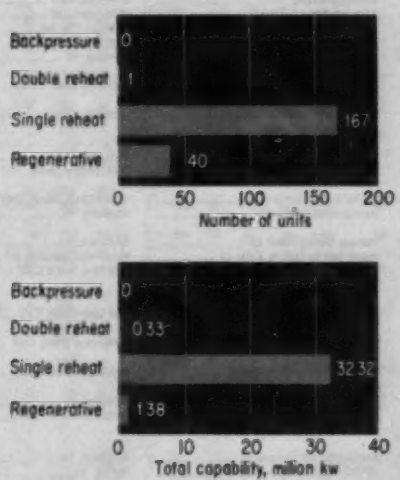
SIX OR SEVEN BLEED POINTS predominate for the high-pressure turbines; most of the units under 1500 psig will have five or less


HEAT RELEASE
Number of boilers
Total number of boilers
Furnace heat release, 1000 Btu per hr per cu ft
Gas and oil fired
Coal fired

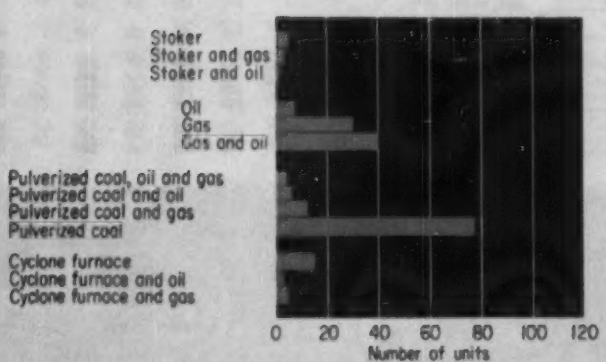
FURNACE HEAT-RELEASE rate between 10-20,000 covers 88% of the coal-fired units while over 20,000 covers 84% of oil and gas fuels



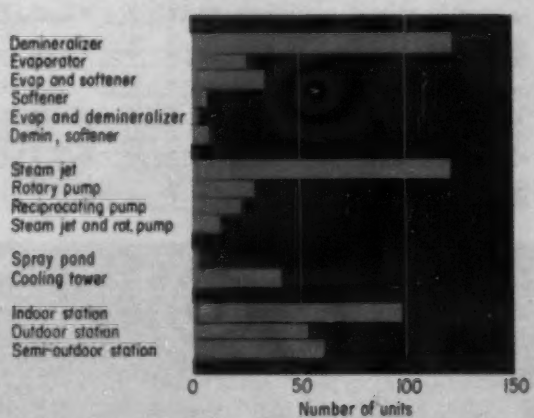
TURBINE CAPABILITIES and number of units show a decrease in smaller units, while the average capacity has grown from 134 mw in 1959 survey to 164 mw for 1960 and later



REHEAT TURBINES now comprise 80% of all units planned, with average size of 193 mw



FIRING EQUIPMENT still shows predominance of king coal; pulverized coal is the most popular fuel, followed by gas-and-oil combination



STATION FEATURES show indoor plants now making up about 46% of the total number of plants planned for completion in 1960 and later

TABLE 1

1960 design survey of typical

Note that each listing covers four pages. The project number helps you keep track of a specific installation after you turn the facing page

Project Number	Company	Location	Plant Name	Consulting Engineers	Unit no., new unit	First operation, new unit	Throttle pressure, psig	Steam temperature F		Number	Capacity each, 1000 lb per hr	*
								Throttle	Reheat			
1	Baltimore Gas & Electric Co	Baltimore County, Md	Charles P Crane	Self	2	1-63	2400	1050	1000	1[12]	1397	
2	Carolina Power & Light Co	Goldsboro, N C	Goldsboro	Ebasco Services, Inc	3	5-62	2400	1000	1000	1[5]	1670	
3	Central Hudson Gas & Electric Corp	Roseton, N Y	Danskammer	Burns & Roe, Inc	4	12-63	2400	1050	1000	1	950	
4	Cincinnati Gas & Electric Co	New Richmond, Ohio	Walter C Beckjord	Sargent & Lundy	5	10-62	2400	1000	1000	1	1300	
5	Cincinnati Gas & Electric Co	Miami Fort, Ohio	Miami Fort	Sargent & Lundy	6[2]	11-60	2400	1050	1000	1	1000	
6	Cleveland Electric Illuminating Co	Cleveland, Ohio	Lake Shore		18	5-62	2400	1000	1000	1	1600	
7	Commonwealth Edison Co	Romeoville, Ill	Will County	Sargent & Lundy	4	3-63	2400	1000	1000	1[3]	3900	
8	Commonwealth Edison Co	Waukegan, Ill	Waukegan	Bechtel Corp	8	6-62	2000	1000	1000	1[3]	2250	
9	Commonwealth Edison Co of Ind, Inc	Hammond, Ind	State Line	Sargent & Lundy	4	5-62	2000	1050	1000	1	2200	
10	Consumers Power Co	West Olive, Mich	James H Campbell	Commonwealth Associates, Inc	1	10-62	2400	1050	1000	1	1750	
11	Consumers Power Co	Essexville, Mich	Dan E Karn	Commonwealth Associates, Inc	2[18]	3-61	2400	1050	1000	1	1750	
12	Delaware Power & Light Co	Wilmington, Del	Edge Moor		4	6-63	2400	1050	1000	1[12]	1160	
13	Delaware Power & Light Co	Delaware City, Del	Delaware City	Bechtel Corp	3	12-61	1250	950	----	1[5]	600	
14	Georgia Power Co	Near Atlanta, Ga	McDonough No. 1	Southern Services, Inc	1	5-63	2400	1000	1000	1	1734	
15	Metropolitan Edison Co	Portland, Pa	Portland	Gilbert Associates, Inc	2	10-62	2400	1050	1000	1[12]	1700	
16	New England Power Co	Somerset, Mass	Brayton Point	Stone & Webster Engrg Corp	1	1963	2400	1000	1000	1	1675	
17	New England Power Co	Somerset, Mass	Brayton Point	Stone & Webster Engrg Corp	2	1963	2400	1000	1000	1	1675	
18	Niagara Mohawk Power Corp	Dunkirk, N Y	Dunkirk		6[2]	6-60	2400	1050	1000	1	1470	
19	Northern Indiana Public Service Co	Valleytown, Ind	Bailly	Sargent & Lundy	7	12-62	2400	1000	1000	1	1200	
20	Pacific Gas & Electric Co	Contra Costa County, Calif	Pittsburg	Self	5[2]	5-60	2400	1050	1000	1[5]	2160	
21	Pacific Gas & Electric Co	Contra Costa County, Calif	Pittsburg	Self	6[2]	2-61	2400	1050	1000	1[5]	2160	
22	Pennsylvania Electric Co	Shawville, Pa	Shawville	Gilbert Associates, Inc	4[2]	3-60	2400	1050	1000	1	1200	
23	Potomac Electric Power Co	Dickerson, Md	Dickerson "B"	Bechtel Corp	3	----	2400	1050	1000	1	1300	
24	Public Service Electric & Gas Co	Woodbridge Township, N J	Sewaren		5[10]	5-62	2400	1100	1050	1[5,16]	2200	
25	Southern California Edison Co	Near Long Beach, Calif	Alamitos	Bechtel Corp	3	1-62	2400	1050	1000	1[5]	2250	
26	Southern California Edison Co	Near Long Beach, Calif	Alamitos	Bechtel Corp	4	8-62	2400	1050	1000	1[5]	2250	
27	Southern California Edison Co	Huntington Beach, Calif	Huntington Beach	Bechtel Corp	3[10]	12-60	2400	1050	1000	1[5,16]	1638	
28	Southern California Edison Co	Huntington Beach, Calif	Huntington Beach	Bechtel Corp	4[10]	7-61	2400	1050	1000	1[5,16]	1638	*
29	Virginia Electric & Power Co	Dumfries, Va	Possum Point	Stone & Webster Engrg Corp	4[6]	4-62	2400	1000	1000	1[5]	1670	
30	Virginia Electric & Power Co	Portsmouth, Va	Portsmouth	Stone & Webster Engrg Corp	4[5]	5-62	2400	1000	1000	1	1670	
31	Virginia Electric & Power Co	Richmond, Va	12th St	Boiler Brick & Refractory Co	----	6-60	200	Sat	----	1[13]	15	
32	Virginia Electric & Power Co	Norfolk, Va	Reeves Ave	Boiler Brick & Refractory Co	----	6-60	200	Sat	----	1[13]	15	¶
33	Central Illinois Public Service Co	Meredosia, Ill	Meredosia	Sargent & Lundy	3[2]	7-60	2000	1050	1000	1	1390	
34	Connecticut Light & Power Co	South Norwalk, Conn	Norwalk Harbor	United Engineers & Constructors, Inc	2	9-62	2000	1000	1000	1	1150	
35	Consolidated Edison Co of N Y, Inc	Astoria, Queens Co, N Y	Astoria		4	1961	2000	1050	1000	1	2500	
36	Consolidated Edison Co of N Y, Inc	Astoria, Queens Co, N Y	Astoria		5	1962	2000	1050	1000	1	2500	
37	Consolidated Edison Co of N Y, Inc	Long Island City, N Y	Ravenswood		1	1963	2000	1050	1000	1	2500	
38	Consolidated Edison Co of N Y, Inc	Long Island City, N Y	Ravenswood		2	1964	2000	1050	1000	1	2500	
39	Florida Power & Light Co	Riviera Beach, Fla	Riviera	Ebasco Services, Inc	3	4-62	2000	1000	1000	1[5]	1950	
40	Florida Power & Light Co	Riviera Beach, Fla	Riviera	Ebasco Services, Inc	4	4-63	2000	1000	1000	1[5]	1950	
41	Florida Power Corp			Black & Veatch	----	7-63	2000	1000	1000	1	1424	
42	New Orleans Public Service Inc	New Orleans, La	Michoud	United Engrs & Constructors, Inc	2	2-63	2000	1000	1000	1[5]	1650	
43	San Diego Gas & Electric Co	Chula Vista, Calif	South Bay	Pioneer Service & Engrg Co	2	7-62	2000	1000	1000	1[5]	980	
44	Southern Electric Generating Co	Wilsonville, Ala	Sogco No. 1	Southern Services, Inc	1[2]	4-60	2000	1000	1000	1	1700	
45	Southern Electric Generating Co	Wilsonville, Ala	Sogco No. 1	Southern Services, Inc	2[2]	7-60	2000	1000	1000	1	1700	
46	Southern Electric Generating Co	Wilsonville, Ala	Sogco No. 1	Southern Services, Inc	3	4-61	2000	1000	1000	1	1700	
47	Southern Electric Generating Co	Wilsonville, Ala	Sogco No. 1	Southern Services, Inc	4	4-62	2000	1000	1000	1	1700	

SYMBOLS USED ABOVE

By - Gas bypass
ByD - Bypass damper
D - Damper
DB - Dry bottom
EA - Excess air
FG - Flue gas recirculation
FR - Firing rate
Hy - Hydraulic coupling
Lo - Inlet louvres
M - Motor
Ma - Magnetic coupling
Mp - Two motors per fan
N - None
No - Number of burners
Pd - Pressurized
Pre - Precondensing
Re - Regenerative
S - Speed control
ST - Stag top
T - Turbine
TB - Tilting burner
TF - Twin furnace
V - Vane control
WS - Water spray
1 - Cyclone
2 - Revised data, previously listed 12-57
3 - Twin furnace
4 - 1080 Btu per sq ft per hr
5 - Outdoor unit
6 - Revised data, previously listed 10-59
7 - 24 coal burners, 12 oil burners, 12 oil pilots per furnace
8 - 8 burner stations; 3 oil guns, 6 gas burners per station
9 - Control division wall forming two corner-fired furnaces
10 - Computer controlled
11 - Firing rate
12 - Semi-outdoor unit
13 - Package boiler for space heating, etc
14 - Tangential
15 - Proportioning dampers
16 - Once through
17 - 32 coal, 24 oil
18 - Revised data, previously listed 10-58

MANUFACTURERS

AC - Allis-Chalmers Mfg Co
AD - Allen B DuMont Laboratories, Inc

new central-station installations

Plant No.	Manufacturer	BOILERS: Surface, 1000 sq ft: Boiler & waterwalls	Superheater	Reheater	Economizer	Air heater	Superheat control	Reheat control	Air heater type	FURNACE: Pressure, in. water	Volume 1000 cu ft	Heat release, 1000 Btu per cu ft per hr	Number of burners	Burners	F-D FANS: No. per boiler	Capacity each, 1000 cfm	Manufacturer	Air flow control	Drive	Drive hp	Drive manufacturer	I-D FANS: No. per boiler	Capacity each, 1000 cfm	Manufacturer	Gas-flow control	Drive	Drive hp	Drive manufacturer	Figure Number
	BW	25.8	112.3	22.0	20.4	333.6	WS,FG	WS,FG	Re	14.8	60.6	28.8	4[1]	ST,Pd	2	217	AS	V	M	2500	WE	N	.....	.....	.....	.....	.....	.....	1
	RS	.....	.....	.....	.....	470.4	WS	D	Re	.....	133.5	16.1	20	DB	2	280	SW	V	M	800	GE	2	340	SW	V	M	1250	GE	2
	CE	17	78.3	16.3	62.7	112.7	WS,TB	WS,TB	Re	-0.60	69.1	17.5	32	DB	2	150	.....	V	M	400	GE	2	240	.....	D	M	1000	.....	3
	CE	27.9	87.4	26.1	69.7	344.4	WS,TB	WS,TB	Re	-0.15	129.5	.....	40	DB	2	283	GF	V	M	1250	AC,WE	2	430	GF	D,Hy	M	2250	AC	4
	CE	19.6	104.6	16.4	27.8	272	WS,TB	WS,TB	Re	0.15	105	13.0	20	DB	2	220	WE	V	M	700	AC	2	277	BF	D,Ma	M	1250	AC	5
	CE	26.3	112.5	28.8	44.6	215.4	WS	WS,TB	Re	12.5	132.5	16.2	40	DB,Pd	2	378	SW	S	T	5320	GE	N	.....	.....	.....	.....	.....	.....	6
	CE	61.3	183.3	68.0	103.2	956.4	WS	TB	Re	14	470	10.2	64	DB,Pd	4	306	GF	V	M	3000	.....	N	.....	.....	.....	.....	.....	.....	7
	CE	45.5	182.6	40.8	63.5	254.4	WS,TB	WS,TB	Re	15.5	254	10.1	....[7]	DB,Pd	2	343	BF	D,Hy	M	4000	WE	N	.....	.....	.....	.....	.....	.....	8
	BW	74.8	177.1	108.5	68.5	543.6	WS,FG	WS	Re	20	264.5	23.9	9	ST,Pd	2	373	GF	V	M	6000	WE	N	.....	.....	.....	.....	.....	.....	9
	CE	26	100.9	22.5	64.2	378.4	TB	WS,TB	Re	0.0	127.5	17.4	40	DB	2	315	WE	V	M	1000	EL	2	490	WE	V	M	1750	EL	10
	BW	25.8	139	30.3	53.6	369	WS,FG	WS	Re	-0.10	136	16.3	24	DB	2	315	WE	V	M	800	WE	2	480	WE	V	M	1750	WE	11
	.....	22.6	77.7	22.2	44.7	151.8	TF	.....	.....	.....	88.8	.....	.....	DB	2	.....	.....	V	M	.....	.....	2	.....	.....	S	M	.....	.....	12
	FW	12.8	15.4	.....	11.0	51.2	WS	.....	Re	.....	43.7	17.2	8	ST	1	178	SW	V	M	600	WE	1	318	SW	D	M	1250	WE	13
	CE	22.4	82.3	29.0	75.5	332	WS,TB	WS,TB	Re	20	154.5	14.7	40	Pd	2	254	GF	V	M	1750	WE	N	.....	.....	.....	.....	.....	.....	14
	CE	23.9	7.9	23.3	65.6	196.9	WS	TB	Re	0.15	153.6	13.8	32	DB	2	289	WE	V	M	785	WE	2	434	WE	V	M	1415	WE	15
	CE	25.9	89	65.4	54.0	343.0	WS	WS,TB	Re	-0.15	131.8	17.2	....[17]	DB	2	304	BF	V	M	800	AC	2	430	BF	V	M	1250	AC	16
	CE	25.9	89	65.4	54.0	343.0	WS	WS,TB	Re	-0.15	131.8	17.2	....[17]	DB	2	304	BF	V	M	800	AC	2	430	BF	V	M	1250	AC	17
	CE	25.0	140.3	18.7	30.9	156.3	WS,TB	WS,TB	Re	0.5	102	18.0	12	DB	2	230	SW	S	M	600	WE	2	340	BF	S	M	1250	WE	18
	BW	32.2	65.0	34.3	27.3	234.8	WS,FG	WS	Re	7.5	76.6	20.8	4[1]	ST,Pd	2	294	WE	V	M	2500	WE	N	.....	.....	.....	.....	.....	.....	19
	BW	44	89	82	78	446	WS,By	WS,[15]	Re	12	135	22	24	Pd	2	414	SW	D,V	M	2250	WE	...	.....	.....	.....	.....	.....	.....	20
	BW	44	89	82	78	446	WS,By	WS,[15]	Re	12	135	22	24	Pd	2	414	SW	D,V	M	2250	WE	...	.....	.....	.....	.....	.....	.....	21
	CE	21.3	125.1	13.2	31.4	305.8	WS	WS,TB	Re	-0.5	96	16.6	8	DB	2	221	SW	V	M	400	GE	2	314	SW	D	M	1000	GE	22
	CE	24.2	105.4	23.6	62.6	237.5	WS,TB	WS,TB	Re	-0.10	93.5	17.6	32	DB[9]	2	210	AS	Lo	M	700	EM	2	295	AS	Hy	M	1000	EM	23
	BW	26.6	196.5	57.7	82.8	568.4	.....[11]	D	Re	30	122.6	25.1	24	ST,Pd	2	308	AS	Hy	M	2500	AC	N	.....	.....	.....	.....	.....	.....	24
	CE	26.7	121.6	24.2	75.5	470	WS,TB, FG	TB,FG	Re	19	112.5	24.2	....[8]	Pd	2	294	AS	D,Hy	M	2250	.....	N	.....	.....	.....	.....	.....	.....	25
	CE	26.7	121.6	24.2	75.5	470	WS,TB, FG	TB,FG	Re	19	112.5	24.2	....[8]	Pd	2	294	AS	D,Hy	M	2250	.....	N	.....	.....	.....	.....	.....	.....	26
	BW	29.0	61.6	47.0	14.0	343	FR	D	Re	8.7	91	128[4]	24	Pd	2	256	BF	Hy	M	1250	WE	N	.....	.....	.....	.....	.....	.....	27
	BW	29.0	61.6	47.0	14.0	172	FR	D	Re	8.7	91	128[4]	24	Pd	2	256	BF	Hy	M	1250	WE	N	.....	.....	.....	.....	.....	.....	28
	CE	53.4	125.7	22.5	64.6	366	WS	WS,TB	Re	-1.5	122	94.9[4]	32	DB	2	270	SW	D,V	M	700	EL	2	369	GF	D	M	1000	EL	29
	CE	53.4	125.7	22.5	64.6	366	WS	WS,TB	Re	-0.15	122	94.9[4]	32	DB	2	270	SW	D,V	M	700	EL	2	369	GF	D	M	1000	EL	30
	BW	1.5	N	N	N	N	.....	.....	.....	.....	0.41	46.6	.....	Pd	1	.....	.....	V	M	.....	FM	...	.....	.....	.....	.....	.....	.....	31
	BW	1.5	N	N	N	N	.....	.....	.....	.....	0.41	46.6	.....	Pd	1	.....	.....	V	M	.....	FM	...	.....	.....	.....	.....	.....	.....	32
	CE	29.5	78.4	15.9	65.0	300.8	TB	TB	Re	-0.5	138.8	14.8	32	DB	2	230	BF	V	M	700	EL	2	335	BF	S,Hy	M	1750	EL	33
	CE	19.3	72.0	16.8	30.0	138.9	WS,TB	WS,TB	Re	-0.10	85.0	17.3	32	DB	2	200	SW	V	M	700	WE	2	350	SW	V	M	1500	WE	34
	CE	48.7	164.6	30.6	117.1	546.8	WS,TB	WS,TB	Re	16	250	13.0	64	DB	4	250	AS	V	M	2000	AC	N	.....	.....	.....	.....	.....	.....	35
	CE	48.7	164.6	30.6	117.1	546.8	WS,TB	WS,TB	Re	16	250	13.0	64	DB	4	250	AS	V	M	2000	AC	N	.....	.....	.....	.....	.....	.....	36
	CE	48.7	164.6	30.6	117.1	546.8	WS,TB	WS,TB	Re	16	250	13.0	64	DB	4	250	AS	V	M	2000	EL	N	.....	.....	.....	.....	.....	.....	37
	CE	48.7	164.6	30.6	117.1	546.8	WS,TB	WS,TB	Re	16	250	13.0	64	DB	4	250	AS	V	M	2000	EL	...	.....	.....	.....	.....	.....	.....	38
	FW	36.1	30.0	80.9	61.2	359.4	Pre	ByO	Re	0.20	110	24	24	DB	2	335	BF	D	M	1000	GE	2	530	BF	D	M	2000	GE	39
	FW	36.1	30.0	80.9	61.2	359.4	Pre	ByO	Re	0.20	110	24	24	DB	2	335	BF	D	M	1000	GE	2	530	BF	D	M	2000	GE	40
	CE	24.7	119.6	24.3	36.0	207.6	WS,TB, FG	WS,TB	Re	.....	153.5	12.7	.....	Pd	2	.....	.....	Hy	M	.....	.....	N	.....	.....	.....	.....	.....	.....	41
	RS	19.5	43.3	79.5	37	344.6	WS	WS,D	Re	8.95	93.8	26.6	16	Pd	2	280	AS	Hy	M	1500	GE	...	.....	.....	.....	.....	.....	.....	42
	BW	16.9	65.9	20.0	11.2	154.4	WS,FG	WS,FG	Re	7.3	.....	139[4]	8	Pd	2	185	AS	S,D,Hy	M	1000	AC	N	.....	.....	.....	.....	.....	.....	43
	BW	30.2	127.9	43.3	28.9	524.4	WS,FG	WS	Re	-0.10	139.5	16.1	18	DB	2	315	AS	D,Hy	M	1000	GE	2	480	AS	D,Hy	M	1500	GE	44
	BW	30.2	127.9	43.3	28.9	524.4	WS,FG	WS	Re	-0.10	139.5	16.1	18	DB	2	315	AS	D,Hy	M	1000	GE	2	480	AS	D,Hy	M	1500	GE	45
	BW	30.2	127.9	43.3	28.9	524.4	WS,FG	WS	Re	-0.10	139.5	16.1	18	DB	2	315	AS	D,V	M	1000	GE	2	480	AS	D,Hy	M	1500	GE	46
	BW	30.2	127.9	43.3	28.9	524.4	WS,FG	WS	Re	-0.10	139.5	16.1	18	DB	2	315	AS	D,V	M	1000	AC	2	480	AS	D,Hy	M	1500	AC	47

AH - American Hoist & Derrick Co
AOS - A O Smith Corp
AP - Alco Products, Inc
AS - American Standard, Ind Div
ASH - Allen-Sherman-Hoff Co
AT - Aerotec Corp
BF - Buffalo Forge Co
BJ - Byron-Jackson Pumps, Inc
BM - Bailey Meter Co
BP - Bingham Pump Co
BU - Buell Engineering Co, Inc

BW - Babcock & Wilcox Co
CB - Chain Belt Co
CE - Combustion Engineering Inc
CFB - C F Braun Co
CHW - C H Wheeler Mfg Co
CIW - Clyde Iron Works
COC - Cochrane Corp
CT - Caterpillar Tractor Co
CV - Copes Vulcan Div, Blaw-Knox Co
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp

EL - Elliott Co
EM - Electric Machinery Mfg Co
FC - Fairfield Engineering Co
FM - Fairbanks, Morse & Co
FW - Foster Wheeler Corp
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GR - Grissom-Russell Co
GW - Graver Water Conditioning Co
HA - Hydro-Aire Corp
HCC - Hagan Chemicals & Controls, Inc

HL - Hoi Laboratories
HM - Hays Manufacturing Co
HP - Hoyt & Patterson, Inc
HR - Hewitt-Robins Inc
HT - Hungerford & Terry, Inc
ID - Industrial Broomhoist Corp
IE - Illinois Electronic Systems
IN - Infilco, Inc
IR - Ingersoll-Rand Co
IW - Illinois Water Treatment Co
KC - Koppers Co, Inc

LAC - Louis-Allis Co
LB - Link-Belt Co
LN - Lewis & Northrup Co
McK - McKiernan Terry Co
McM - McNally Pittsburg
NR - Nilten Roy Co
MS - Maryland Shipbuilding & Drydock Co
OH - O'Neal Steel Inc
PC - Pennsylvania Crusher
PM - Permutit Co, Div Pfaudler Permutit

Central-station installations TABLE 1 continued

Project Number	BOILER FEED PUMPS							FUELS								FIRING										
	Capacity each, gpm	Discharge pressure, psig	Manufacturer	Flow control	Drive	Drive hp	Drive manufacturer	Fuel type	Heating value, 1000 Btu per lb	Ash fusion temperature, F	Fuel delivery method	Coal unloading system	Unloading system manufacturer	Handling system to storage	Handling system manufacturer	Coal firing equipment	Firing equipment manufacturer	No. pulverizers per boiler	Ash-handling system	Ash-handling system manufacturer	Soot blower type	Soot blowing medium	Soot blower manufacturer	Dust collector type	Dust collector manufacturer	Stack height, ft
1	3035[29] 1540[38] 3182[35]	2910 2650 277	BJ	S[29] R[38]	T M 2M	5800 3000 400	WE	C	13.5	2352[34]	RR	Dump	Ex	Co, Bu	SA	Cy	PC	4[31]	Pn, Hyd	UC	Ret	Air	DP	El	KC	353
2	2100	2800	IR	Hy	2M	3500	GE	C	13.2	2100	RR	CS	HR	Co, Bu	HR	P	RS	5	Pn, Hyd	.....	Ret	Air	CV	Me	WP	250
3	1135	3006	.....	R	2M	2500	.....	C	13.0	2000	RR	CS	Ex	Co	CB	P	CE	4	Hyd	.....	Ret	Air	.....	Me	.....	151
4	2000	2940	PP	Hy	2M	4000	AC	C	11.5	2350	Ba	Ct	.....	Sc	CT	P	CE	5	Hyd	UC	.....	Air	.....	El	BU	450
5	1300	2940	PP	Hy	3M	2500	AC	C	11.5	2350	Ba	.....	.....	Sc	CT	P	CE	5	Hyd	UC	Ret	Air	DP	Me, El	RC	325
6	2131	3069	WO	S	2T	5190	GE	C	12.2	2000	RR, Tr	Dump	WL	Co	SA	P	CE	5	Hyd	ASH	Ro, Ret	St	DP	El	KC	320
7	4100	3068	BJ	S	3T[28]	9700	GE	C	10.7	1990	Ba	CT	WL	Bu, Sc	LB	P	CE	8	Pn, Hyd	.....	Ro, Ret	Air	DP	El	.....	500
8	2300	2400	DL	Hy	1M, 1T[39]	4900	WE	C, O	10.0	1950	RR	Dump	LB	Co, Bu, Sc	LB SA	P	CE	6	Pn	UC	Sta, Ro, Ret	St Air	DP	El	KC	450
9	2645	2805	IR	Hy	2M	4500	EL	C	10.0	2000	RR	Dump	.....	Co, Bu	.....	Cy	.....	...	Pn, Hyd	UC ASH	Sta, Ro, Ret	St	DP	El	RC	450
10	2100	3000	AC	Hy	1M, 2T[30]	3000	AC	C	10.7	2100	.....	.....	.....	.....	.....	P	CE	5	Hyd	HA	Ret	Air	DP	El	KC	.....
11	1400	3000	PP	R	3M	3000	GE	C	10.7	2100	Sh	Sb	.....	Bu	HR	P	BW	6	Hyd	ASH	Ret	Air	DP	El	KC	350
12	.....	.....	.....	Hy	.....	.....	.....	C, O, G	13.4	2400	.....	Dump	.....	Co, Bu	.....	P	.....	4	Pn, Hyd	.....	.....	.....	.....	.....	.....	.....
13	750	1800	WO	Hy	2M	1000	AC	FPC, O	14.3	2500	Co	.....	.....	Co	.....	P	FW	2	.....	.....	.....	.....	.....	Me	AT	500
14	2240	3000	PP	Hy	2M	5000	EL	C	12	2100	RR	Dump	LB	Co	.....	P	CE	5	Hyd	ASH	Ro, Ret	St	CV	El	BU	.....
15	4450	3054	IR	S	1M[32], 1T	9813	GE	C	13.3	2000[22]	RR	.....	.....	Co	FE	P	CE	4	Pn, Hyd	UC	Ro, Ret	Air	CV	Me, El	BU	400
16	4320 2400	2960	IR	R	.....[30] 1M	10,000 4000	.....[30] AC	C, O[20]	12.0	2100[22]	Sh	Ct	.....	Bu	.....	P	CE	4	Pn, Hyd	.....	Ro, Ret	Air	DP	El	KC	350
17	4320 2400	2960	IR	R	.....[30] 1M	10,000 4000	.....[30] AC	C, O[20]	12.0	2100[22]	Sh	Ct	.....	Bu	.....	P	CE	4	Pn, Hyd	.....	Ro, Ret	Air	DP	El	KC	350
18	3424	2765	PP	S	1T	6800	GE	C	13.15	2100	RR	Dump	LB	Co	SA	P	CE	6	Pr	UC	Ret	Air	DP	Me, El	RC	325
19	1390	2820	IR	R, Hy	2M	3000	EL	C, G	10.0	2400	RR	Dump	LB	Co, Bu	LB	Cy	.....	...	FA	UC	Ret	Air	CV	El	WP	.....
20	2700	2900	WO	S, Hy	2T[30]	.....	.....	O, G	18.5	.....	Sh, Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	St	DP	.....	.....	450
21	2700	2900	WO	S, Hy	2T[30]	.....	.....	O, G	18.5	.....	Sh, Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	St	DP	.....	.....	450
22	1530	2977	PP	Hy	2M	3000	GE	C	12.8	2100	RR	Dump	LB	Co	SA	P	CE	4	Hyd	UC	Sta, Ret	St	CV	Me, El	RC	325
23	3100	2900	WO	Ed	1T[30], 1T[36]	6240[36]	GE	C	11.0	2000	RR, Tr	Dump	LB	Co, Bu	LB	P	CE	4	Pn, Hyd	ASH	Ro, Ret	St	DP	El	RC	400
24	2900	3480	WO	Hy	1M[32], 2T[30]	5000[32]	AC	O, C[20]	18.6	.....	Ba, Pi	.....	.....	.....	.....	P[20]	.....	...	.....	.....	Ro, Ret	Air	CV	.....[33]	WP	325
25	4610[29] 2200[32]	2740 1580	BJ PP	Hy	1T 1M	.....[39] 3500	GE	G, O	1093[27]	.....	Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	Air	CV	N	.....	200
26	4610[29] 2200[32]	2740 1580	BJ PP	Hy	1T 1M	.....[39] 3500	GE	G, O	1093[27]	.....	Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	Air	CV	N	.....	200
27	3470[29] 1290[32]	3570 1400	PP PP	Hy	1T 1M	.....[39] 1500	GE GE	G, O	1093[27]	.....	Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	Air	DP	N	.....	200
28	3470[29] 1290[32]	3570 1400	PP	Hy	1T 1M	.....[39] 1500	WE GE	G, O	1093[27]	.....	Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	Air	DP	.....	.....	200
29	4185	2853	IR	S	1M[24], 1T	8650	GE	C, O	13.1	2500	RR	CS	SA	Co, Bu	SA	P	CE	4	Hyd	ASH	Ret	St	DP	El	RC	175
30	4185	2853	IR	S	1M[24], 1T	8650	WE	C, O	13.1	2500	RR	CS	LB	Co, Bu	LB	P	CE	4	Hyd	ASH	Ret	St	DP	El	RC	200
31	.....	.....	IR	R	M	.....	LAC	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	N	.....	.....
32	.....	.....	IR	R	M	.....	LAC	O, G	.....	.....	.....	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	N	.....	.....
33	1620	2339	WO	Hy	3M	3000	EL	C	10.5	2000	Ba, RR	CS, BaU	AH	Co	SA	P	CE	8	Hyd	UC	Ret	St	CV	El	KC	150
34	2380	2550	IR	Hy	2M	3000	WE	C	13.2	2200	Ba	CT	Ex	Co	Ex	P	CE	4	Hyd, Pn	UC	Ro, Ret	Air	CV	Me, El	RC	Ex
35	6330 3165	2460 2560	BJ	Hy R	1T[30] 1M	12,000 6000	.....[30] EL	C	13.6	1900	Ba	CT	Ex	.....	SY	P	CE	8	Pn, Hyd	UC	Ret	St	CV	Me, El	RC	300
36	6330 3165	2460 2560	BJ	Hy R	1T[30] 1M	12,000 6000	.....[30] EL	C	13.6	1900	Ba	CT	LB	Co	LB	P	CE	8	Pn, Hyd	UC	Ret	St	CV	Me, El	RC	300
37	6330 3165	2460 2560	BJ	Hy R	1T[30] 1M	12,000 6000	.....[30] EL	O, G	18.4	.....	Ba	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	St	CV	N	.....	500
38	6330 3165	2460 2560	BJ	Hy R	1T[30] 1M	12,000 6000	.....[30] EL	O, G	18.4	.....	.....	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	St	CV	N	.....	500
39	2465	2800	AC	R	3M	4500	GE	O, G	18.1	.....	Pi, Sh	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	St	DP	Me	RC	300
40	2465	2800	AC	R	3M	4500	GE	O, G	18.1	.....	Sh, Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	St	DP	Me	RC	300
41	.....	.....	BJ	Hy	1M, 1T[30]	.....	.....	O, G	18.2	.....	Ba, Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	.....	.....	N	.....	.....
42	2075	2820	BJ	Hy	2M	4800	GE	G	1033[27]	.....	Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	186
43	1320	2409	PP	S, Hy	2M	2500	AC	O, G	17.9	.....	Ba, Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	Ret	St	.....	.....	.....	50[40]
44	2100	2390	PP	Hy	3M	4000	GE	C	12.0	2550	RR	Dump	HP	Co	Tl, ON	P	BW	6	Pn	ASH	Ro, Ret	St	DP	El	WP	250
45	2100	2390	PP	Hy	3M	4000	GE	C	12.0	2550	RR	Dump	HP	Co	Tl, ON	P	BW	6	Pn	ASH	Ro, Ret	St	DP	El	WP	250
46	2100	2390	PP	Hy	2M	4000	GE	C	12.0	2550	RR	Dump	HP	Co	Tl, ON	P	BW	6	Hyd	ASH	Ro, Ret	St	DP	El	WP	250
47	2100	2390	PP	Hy	2M	4000	GE, EL	C	12.0	2550	RR	Dump	HP	Co	.....	P	BW	6	Hyd	ASH	Ro, Ret	St	DP	El	KC	250

PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc
RCA - Radio Corporation of America
RF - Republic Flow Meters Co
RM - Republic Manufacturing Co
RO - Robbins & Meyers, Inc
RS - Riley Stoker Corp
SA - Stephens-Adamson Mfg Co
SW - Sturtevant Div, Westinghouse Electric Corp
SWC - Struthers Wells Corp

SY - Sy-Co Corp
TI - Transail Inc
UC - United Conveyor Corp
WE - Westinghouse Electric Corp
WL - Wellman Conveyors
WO - Worthington Corp
WP - Western Precipitation Corp
YU - Yuba Heat Transfer Div

SYMBOLS USED ABOVE

AAB - Arsenical Aluminum Brass
Ad - Admiralty
Adi - Admiralty, Inhibited
Al - Aluminum
AlB - Aluminum Brass
AsAd - Arsenical Admiralty
AsAlCu - Arsenical Aluminum Copper
AsCu - Arsenical Copper
Ba - Barge
BaU - Barge unloader
Bu - Bulldozer
C - Coal, Bituminous
CC - Cross compound
Cl - Clam
CN - Cupro Nickel
Co - Conveyor
Con - Condenser
CS - Car Shaker
C-s - Coal, sub-bituminous
CT - Coal tower
Cy - Cyclone
De - Demineralizer
Dump - Dumper
Ed - Eddy current coupling
El - Electrostatic
Ev - Evaporator
Ex - Existing
FA - Fly ash reinjection
FPC - Fluid petroleum coke
G - Gas
GC - Gas cooled
H - Heater
Hy - Hydrogen
HC - Hollow conductor

	HEATER					CONDENSER								TURBINES									CONTROLS					
	Number	Hi-press heater out temperature, F	Max operating pressure, psia	Manufacturer	Deaerator	Surface, 1000 sq ft	No. of water passes	Tube material	Air removal	Manufacturer	Feedwater treatment (raw water)	Feedwater pH	System manufacturer	Number	Capability each, 1000 kw	Turbine type	Manufacturer	Exhaust pressure, psia	No. of bleedpoints	No. main turbine exhausts	Main generator voltage, kv	Generator rating, 1000 kva (max)	Generator cooling	Combustion control mfr	Feedwater control mfr	Closed-circuit TV mfr	Total boiler capacity including new units, 1000 lb per hr	Total generator capability including new units, 1000 kw	Report Number
	6	480	117	GR,WO	H	105	1	AAB	RP	WO	Do	8.5	GW	1	190	TC	WE	0.75	6	3	20	224	H_2,HC	BM	BM	N	2714	380	1
	7	471	.....	WE	Hot	145	2	Al	Ro	WE	So,Ev	10	MW	1[5]	253	TC	WE	1.75	7	3	18	265	H_2,HC	.....	AS	.....	2940	422	2
	7	516	91	.....	H,Hot	95	1	Ad	J	.....	De	8	Ex	1[23]	140	TC	GE	0.5	7	3	16.0	173	H_2	.....	.....	.....	3060	420	3
	6	477	131.7	WE	H	115	2	AsAd	RP	AC	Do	8	.....	1	250	TC	GE	0.75	6	2	22	261.8	LI	.....	.....	.....	4982	744	4
	7	472	124	WE	H	80	2	AsAd	RP	WO	Do	8	PM	1	175	TC	GE	0.75	7	2	18.0	192	H_2	BM	BM	DP	4740	528	5
	8	475	55	WE	H	105	1	Ad	J,Ro	IR	De	8.5	IW	1	250	TC	GE	0.5	8	3	18	320	H_2,HC, LI	.....	.....	.....	4430	554	6
	7	528	134	AOS	H	350	1	Ad	J	FW	De	8.5	.....	1[19]	532	CC	GE	0.5	7	4	20	640	H_2,LI	.....	.....	.....	8100	1107	7
	7	475	99.8	CFB, WE, GW	H	180	1	Ad	J,Ro	FW	De	8.8	.....	1[19]	325	CC	WE	0.5	7	2	18	211 173	H_2	BM	BM	DP	8193	1056	8
	7	474	82	GR, COC	H,Hot	200	1	.....	J	WO	De	8.5	IN	1[19]	325	CC	WE	0.5	7	2	18	416	HC,GC	RF	RF	IE DP	7600	867	9
	8	518	76.9	AC, AP	H,Hot	100	1	Ad1	Ro	YU	De	9.5	COC	1	265	CC	AC	0.5	8	4	16	156[21]	HC,GC	RF	RF	.....	1750	265	10
	8	520	.....	CFB	Hot	115	1	Ad1	RP	FW	De	9.5	COC	1	265	CC	WE	0.5	8	4	16	166[21]	HC,GC	RM	CV	.....	3500	530	11
	...	.....	.....	.....	.....	.....	...	.....	Ro	.....	.....	.....	.....	1	150	TC	.....	.....	...	...	13.8	.....	.....	.....	.....	.....	.....	366	12
	5	420	.....	GR	H	55	2	CNi	RP	AC	De	8	Ex	1[23]	66	TC	AC	0.75	5	2	13.8	76.8	H_2	BM	BM	.....	2100	116	13
	7	472	79	GW	H	165	2	Ad	RP	FW	De	9.2	.....	1	265[25]	TC	GE	0.75	6	2	20	320	H_2,LI	.....	.....	.....	1734	245[25]	14
	8	524	100	WE,EL	H,Hot	95	1	Ad	RP	IR	De	8.7	IW	1[19]	225.4	CC	GE	0.75	4	1	15.5	150	H_2	LN	HCC	N	2850	415	15
	7	495	101.5	GR,COC, WE	H,Hot	115	1	CNi	J,Ro	WE	Ev,De	9.0	.....	1[19]	225	CC	GE	0.5	7	2	18	260	H_2	HCC	HCC	.....	1675	225	16
	7	495	101.5	GR,COC, WE	H,Hot	115	1	CNi	J,Ro	WE	Ev,De	9.0	.....	1[19]	225	CC	GE	0.5	7	2	18	260	H_2	HCC	HCC	.....	3350	450	17
	11	525	40	AP,WO	H	95	1	Ad	J	WO	De	9.0	PM	1[19]	210	CC	GE	0.5	7	1	13.8	128	H_2	BM	BM	DP	4340	560	18
	5	457	122	FW	H	90	1	PAd	J,Ro	IR	De,So	7.0	COC	1[23]	193	TC	GE	0.75	7	2	22	234	H_2	.....	.....	.....	1200	193	19
	7	480	.....	CFB,YU	Hot	130	1	AlB	J	YU	So,Ev	8.5	Ex	1[5,37]	325	CC	WE	0.75	7	4	18	192	HC,GC	BM	BM	DP	6696	905	20
	7	480	.....	CFB,YU	Hot	130	1	AlB	J	YU	So,Ev	8.5	Ex	1[5,37]	325	CC	GE	0.75	7	4	18	192	H_2	BM	BM	DP	8856	1310	21
	9	472.5	109.5	GR,SWC WO	H,Hot	110	2	SS	J	WE	De	.....	GW	1	191	TC	GE	0.5	7	...	22	223	H_2,LI	BM	BM	.....	2070	635	22
	10	511	93	GR	H,Hot	110	2	AsAd	RP	WO	De	8	GW	1[19]	175	CC	GE	1.75	7	1	13.8	230	H_2	BM	BM	DP	3900	525	23
	8	532	Con	YU	Hot	160	1	AlB	Ro	WE	De	8.8	COC	1[37]	342	CC	WE	0.62	8	4	18	458	H_2,GC	.....	.....	.....	5913	817	24
	8	528	147.3	.....	H,Hot	145	2	AlB	J,RP	IR	So,Ev	8.8	.....	1[5,19]	310	CC	GE	0.75	8	1	18	370	H_2	HCC	HCC	.....	7000	1000	25
	8	528	147.3	.....	H,Hot	145	2	AlB	J,RP	IR	So,Ev	8.8	.....	1[5,19]	310	CC	GE	0.75	8	1	18	370	H_2	HCC	HCC	.....	7000	1000	26
	7	535	116.8	CFB	H,Hot	110	2	AlB	J,RP	IR	De	9	PM	1[5,19]	210	CC	GE	0.75	7	1	13.8	256	H_2	BM	BM	N	6220	860	27
	8	532	115.4	WE	H,Hot	105	1	AlB	J,RP	IR	De	9	PM	1[5,37]	210	CC	WE	0.75	8	2	13.8	256	H_2	BM	BM	N	6220	860	28
	9	488	100	CFB	H	130	2	Ad	J	IR	Ev	8.8	GR	1	235	TC	GE	0.75	7	3	22	282	H_2,LI	BM	BM	DP	3670	497	29
	9	488	100	CFB	H	115	1	CNi	J	IR	So,Ev	8.8	GR	1	235	TC	WE	0.75	7	3	22	282	H_2,HC GC	BM	BM	DP	4295	626	30
	...	.....	.....	.....	.....	.....	...	.....	.....	.....	So[26]	.....	.....	.....	.....	.....	.....	.....	...	...	.....	.....	.....	HM	.....	.....	865	.....	31
	...	.....	.....	.....	.....	.....	...	.....	.....	.....	So[26]	.....	.....	.....	.....	.....	.....	.....	...	...	.....	.....	.....	HM	.....	.....	1505	.....	32
	10	457	105	GR,COC	H,Hot	125	2	AsCU	J	CHW	De	9	GW	1	214	TC	AC	0.75	6	3	20	256	H_2,HC	BM	BM	.....	2990	329	33
	6	499	.....	GR	Hot	70	1	AlB	J,Ro	CHW	So,Ev	9.6	.....	1	150	TC	GE	1.75	6	1	20	175	H_2,LI	BM	BM	N	1150	150	34
	7	486	159	GR YU	H	198	1	AlB	J	CHW	Ev	.....	.....	1[19]	357	CC	AC	1.0	7	2	20	227 213	HC,GC	HCC	HCC	HCC	.....	.....	35
	7	486	159	GR YU	H	198	1	AlB	J	CHW	Ev	.....	.....	1[19]	357	CC	AC	1.0	7	2	20	227 213	HC,GC	HCC	HCC	AD	10,070	1499	36
	7	486	159	CFB	H	198	1	AlB	J	CHW	Ev	.....	.....	1[19]	363	CC	GE	1.0	7	2	20	212 234	HC,GC	HCC	HCC	HCC	2500	363	37
	7	486	157	CFB	.....	198	...	AlB	J	CHW	Ev	.....	.....	1[19]	363	CC	GE	1.0	7	2	20	212 234	HC,GC	HCC	HCC	HCC	5000	726	38
	7	464	175	YU,COC	H	135	1	AlB	.....	FW	De	9.5	.....	1[5]	300	TC	GE	1.75	7	3	20	332	H_2,LI	.....	.....	N	3100	435	39
	7	464	175	YU,COC	H	135	1	AlB	.....	FW	De	9.5	.....	1[5]	300	TC	GE	1.75	7	3	20	332	H_2,LI	.....	.....	N	5050	735	40
	6	452	75	.....	.....	125	1	CNi	.....	WE	.....	.....	.....	1	204	TC	GE	1.75	7	3	22	280	LI	.....	.....	.....	.....	.....	41
	7	472	169	GR	H	115	1	CNi	.....	FW	So,Ev	10.1	HT	1[5]	227[25]	TC	GE	1.75	7	1	18	280	H_2,LI	.....	.....	.....	2625	327[25]	42
	7	454	100	CFB	H	.....	2	AlB	J	WO	Ev	.....	.....	1[5]	137[25]	TC	WE	0.75	7	2	15	160	H_2	.....	.....	.....	1834	273	43
	8	467	88.8	YU,GW	H,Hot	150	2	Ad	RP	FW	De	.....	.....	1[19]	250	CC	GE	1.0	6	1	15	320	H_2	BM	BM	N	6800	1000	44
	8	467	88.8	YU,GW	H,Hot	150	2	Ad	RP	FW	De	.....	.....	1[19]	250	CC	GE	1.0	6	1	15	320	H_2	BM	BM	N	6800	1000	45
	8	465	93.6	YU,GW	H,Hot	145	2	Ad	RP	FW	De	.....	.....	1[37]	250	CC	WE	1.0	6	4	15	320	H_2	BM	BM	N	6800	1000	46
	8	465	93.6	YU,GW	H,Hot	145	1	Ad	RP	CHW	De	.....	.....	1[37]	250	CC	WE	1.0	6	4	15	288	H_2	BM	BM	N	6800	1000	47

Bkp - Bump hopper
Cnd - Condensor turbomit
Hy - Hydraulic coupling
Hyd - Hydraulic
J - Steam jet
LI - Liquid
M - Motor
Me - Mechanical
N - None
O - Oil
P - Pulverizer
PAd - Phosphorized Admiralty
Pl - Pipeline
Pn - Pneumatic
Pr - Pressure type
R - Regulator
Ret - Retractable
Ro - Rotary pump or blower
RP - Reciprocating pump
RR - Railroad
S - Speed control
Sb - Self Unloading boat
SC - Single cylinder
Sc - Scraper
Sh - Ship
So - Softener
SS - Stainless steel
St - Steam
Sta - Stationary
T - Turbine drive
TC - Tandem compound
Tr - Truck
3D - 3600/3600 rpm
26 - Future
21 - For each of 2 generators
22 - Softening temperature
23 - Preferred standard
24 - 1/4 size, reduced pressure for startup
25 - Nameplate
26 - Zeolite and deaerator
27 - Btu per cu ft
28 - Half size
29 - Main pump
30 - Main turbine shaft
31 - Crushers
32 - Start-up pump
33 - Initially, shell only
34 - Liquid
35 - Boosters
36 - Full capacity standby
37 - 3600/3600 rpm
38 - Spare and start-up pump
39 - Generator shaft
40 - Above structure

TABLE 2

1960 design survey of typical

Compiled by: BGA Skrotzki, Associate Editor and Althea Thornton

Project Number	Company	Location	Plant Name	Consulting Engineers	Unit No., new unit	First operation, new unit	Throttle pressure, psig	Steam temperature, F: Throttle	Steam temperature, F: Reheat	Number	Capacity each, 1,000 lb per hr	*
48	Arizona Public Service Co	Joseph City, Arizona	Cholla	Ebasco Services, Inc	1	5-62	1800	1000	1000	1[5]	800	
49	Atlantic City Electric Co	Beesleys Point, N J	Beesleys Point	Bechtel Corp	1	11-62	1450	1000	1000	1[12]	927	
50	Boston Edison Co	Everett, Mass	Mystic	Jackson & Moreland Inc	6	5-61	1800	1000	1000	1	935	
51	Central Illinois Light Co	Near Bartonville, Ill	E D Edwards	Commonwealth Associates, Inc	1	5-60	1800	1000	1000	1	850	
52	Iowa-Illinois Gas & Electric Co	E of Davenport, Iowa	Riverside	Sargent & Lundy	5[6]	5-61	1400	1000	1000	1	860	
53	Iowa Power & Light Co	Tracy, Iowa	Tracy	Black & Veatch	1	1964	1800	1000	1000	1[12]	1045	
54	Iowa Public Service	Near Sioux City, Iowa		Ebasco Services, Inc	1	4-64	1800	1000	1000	1	1000	
55	Kansas Power & Light Co	Tecumseh, Kan	Tecumseh	Black & Veatch	8	4-62	1800	1000	1000	1[5]	942	
56	Louisville Gas & Electric Co	Louisville, Ky	Cane Run	Pioneer Service & Engrg Co	4	4-62	1800	1000	1000	1	1300	
57	Monongahela Power Co	Willow Island, W Va	Willow Island	Sanderson & Porter	2	10-60	1800	1000	1000	1[12]	1260	
58	Southwestern Electric Power Co	Morris County, Texas	Wilkes	Sargent & Lundy	1	4-63	1800	1000	1000	1[5]	1100	
59	Utah Power & Light Co	Kemmerer, Wyo	Kemmerer	Bechtel Corp	1	8-63	1800	1000	1000	1[5]	1200	
60	Indianapolis Power & Light Co	Indianapolis, Ind	Elmer W Stout	Gibbs & Hill, Inc	6[3]	6-61	1535	1000	1000	1	750	
61	Columbus & Southern Ohio Electric Co	Conesville, Ohio	Conesville	Black & Veatch	3	1962	1450	1000	1000	1[12]	1000	
62	Interstate Power Co	Sherburn, Minn	Fox Lake	Sargent & Lundy	3	7-62	1450	1000	1000	1	525	
63	Iowa Electric Light and Power Co	Marshalltown, Iowa	Sutherland		3	5-61	1450	1000	1000	1	600	
64	Pacific Power & Light Co	Glenrock, Wyo	Dave Johnston	Ebasco Services, Inc	2[6]	11-60	1450	1000	1000	1[12]	750	
65	Southwestern Public Service Co	Amarillo, Texas	Nichols	Self	2	5-62	1450	1000	1000	1[12]	800	
66	Tucson Gas, Electric Light & Power Co	Tucson, Ariz	Irvington	Sanderson & Porter	3	5-62	1400	1000	1000	1[12]	800	
67	Wisconsin Power & Light Co	Cassville, Wis	Nelson Dewey	Sargent & Lundy	2	12-62	1400	1000	1000	1	700	
68	Southern Nevada Power Co	East Las Vegas, Nev	Clark	Stearns-Roger Mfg Co	3[3]	5-61	1250	950	----	1[5]	690	
69	Black Hills Power & Light Co	Rapid City, S D	Ben French	Stearns-Roger Mfg Co	1	11-60	850	900	----	1[12]	250	
70	Public Service Co of Oklahoma	Oologah, Okla		Black & Veatch	---[8]	----	735	400	----	1	26[13]	
71	San Diego Gas & Electric Co	National City, Calif		Pioneer Svc & Engrg Co	---[15]	5-60	225	397	----	1	30	
	MUNICIPAL, FEDERAL AND COOPERATIVE INSTALLATIONS											
72	City of Jacksonville	Jacksonville, Fla	Talleyrand		10	12-61	1890	1000	1000	1[12]	1000	
73	San Antonio Public Service Board	San Antonio, Texas	W B Tuttle	Gibbs & Hill, Inc	4	3-63	1800	1005	1005	1[5]	1180	
74	Salt River Power District	Glendale, Ariz	Agua Fria	Bechtel Corp	3	5-61	1800	1000	1000	1[5]	1200	
75	Springfield City Utilities	Springfield, Mo	James River	Burns & McDonnell Engrg Co	3[2]	4-60	1350	950	----	1	400	
76	City of Colorado Springs	Colorado Springs, Colo	South Steam Plant	Lutz & May	5	10-62	1250	950	----	1	425	
77	Lansing Board of Water and Light	Lansing, Mich	Moores Park	Beakly, Benjamin & Woodhouse, Inc	1	6-61	1250	950	----	1	430	
78	Holland Board of Public Works	Holland, Mich	James DeYoung	Black & Veatch	4	6-61	935	900	----	1	220	
79	City of Gainesville	Gainesville, Fla		Ebaugh & Goethe	1	6-61	875	900	----	1	240	
80	Celina Municipal Utilities	Celina, Ohio	Celina	Beisswenger-Hoch & Assoc	3	8-60	600	900	----	1	78	
81	Raton Public Service Co	Raton, N Mex	Raton	Burns & McDonnell Engrg Co	5	10-61	630	825	----	1	75	
82	City of Grand Haven	Grand Haven, Mich	Island	Lutz & May	1[6]	4-61	600	825	----	1	125	
83	City of Grand Haven	Grand Haven, Mich	Island	Lutz & May	2[6]	4-61	600	825	----	1	125	
84	Holyoke Gas & Electric Dept	Holyoke, Mass	City Electric Station	P J Kennedy	1	6-61	450[14]	750	----	1	200	
85	Winnetka Water & Light Dept	Winnetka, Ill	Winnetka	Sargent & Lundy	7	9-60	450	750	----	----	----	
86	City of Breese	Breese, Ill		Rogers-Schmidt	----	7-60	310	700	----	1	35	
87	City of Piqua, Ohio	Piqua, Ohio	Municipal		7	5-61	----	----	----	1	----	

SYMBOLS USED ABOVE

BD - Balanced draft
By - Gas bypass
CGS - Chain grate stoker
Cool - Boiler water cooling
D - Damper
DB - Dry bottom
Du - Dust drive
EA - Excess air
FG - Flue gas recirculation
Hy - Hydraulic coupling
M - Motor
Mc - Magnetic coupling
Mp - Two motors per fan
N - None
Pd - Pressurized
Pl - Plate
Re - Regenerative
S - Speed control
ST - Slag tap
TB - Tilting burners
Tu - Tubular
V - Vane control
WS - Water spray
1 - 26 gas, 12 oil
2 - Revised data, previously listed 12-57
3 - Revised data, previously listed 10-58
4 - 1080 lb per hr
5 - Outdoor unit
6 - Revised data, previously listed 10-59
7 - 16 coal, 26 gas
8 - Space heating boiler
9 - Tangential
10 - Cyclone
11 - 1000 Btu per sq ft per hr
12 - Semi-outdoor unit
13 - Million Btu per hr
14 - Future 1250
15 - Fuel oil heating boiler

MANUFACTURERS

AC - Allis-Chalmers Mfg Co
AD - Allen B DuMont Laboratories, Inc
AOS - A O Smith Corp
AP - Alco Products, Inc
AS - American Standard, Ind Div
ASH - Allen-Sherman-Hoff Co
BF - Buffalo Forge Co
BI - Bolco Industrial Equipment
BJ - Byron-Jackson Pumps, Inc
BM - Bailey Meter Co
BP - Bingham Pump Co
BU - Buell Engineering Co, Inc
BW - Babcock & Wilcox Co
CE - Combustion Engineering, Inc

new central-station installations

	BOILERS									FURNACE					F-D FANS							I-D FANS							
		Surface, 1000 ft																											
	Manufacturer	Boiler & waterwalls	Superheater	Reheater	Economizer	Air heater	Superheat control	Reheat control	Air heater type	Pressure, lb. of water	Volume, 1000 cu ft	Heat release, 1000 Btu per cu ft per hr	No. of burners	Bottom	No. per boiler	Capacity each, 1000 cfm	Manufacturer	Air flow control	Drive	Drive hp	Drive manufacturer	No. per boiler	Capacity each, 1000 cfm	Manufacturer	Gas flow control	Drive	Drive hp	Drive manufacturer	Mount'l Number
CE	.....	.....	.....	.....	.....	WS	WS,TB	Re	.....	.....	.....	16	DB	2	.....	.....	.....	M	.....	.....	2	.....	.....	.....	M	.....	.....	48
BW	18.3	59.0	18.3	11.3	84.0	WS,FG	WS,FG	Re	22	46.5	25.6	3[10]	ST,Pd	2	181	.....	D,V	M	2000	.....	N	.....	.....	.....	.....	.....	.....	49
CE	26	78	14.1	17.4	111.9	WS,TD	WS,TB	Re	0.15	58.8	21.3	32	DB	2	176	SW	V	M	600	WE	2	283	SW	V	M	1250	WE	50
RS	48.6	42.2	45.6	13.6	178.8	WS,By	By	Re	0.10	73.5	16.2	16	DB	2	168	GF	D	M	400	GE	2	259	GF	V	M	700	GE	51
CE	17.5	69.0	14.1	15.0	225	WS,TB	WS	Re	-0.15	87	13.8	7	DB	2	180	GF	V	M	500	EL	2	225	GF	Hy	M	1000	EL	52
BW	.....	.....	.....	.....	.....	WS,FG	WS	Re	.....	.....	.....	3[10]	ST	2	.....	.....	.....	M	.....	.....	N	.....	.....	.....	.....	.....	.....	53
BW	18.0	.....	.....	17.5	256	WS,FG	WS	Re	11	56.5	23	3[10]	ST,Pd	2	650	.....	D,V	M	1750	.....	...	.....	.....	.....	.....	.....	.....	54
CE	.....	.....	.....	.....	.....	WS,TB	WS,TB	Re	.....	.....	.....	.....	DB	2	.....	WE	Hy	M	1500	GE	N	.....	.....	.....	.....	.....	.....	55
CE	25.2	47.3	20.6	50.0	162.6	WS	FG	Re	0.10	108	14.9	16	DB	2	250	BF	Hy	M	700	AC	2	350	BF	Hy	M	1250	AC	56
BW	23.5	76.5	23.7	21.5	168.8	FG,WS	FG,WS	Re	.....	.....	84.5[11]	5[10]	ST,Pd	2	782[6]	SW	V	M	3500	GE	N	.....	.....	.....	.....	.....	.....	57
CE	13.4	40.3	12.8	30.3	96.6	WS,TB	WS,TB	Re	8.7	60.0	28.0	40	Pd	2	200	.....	V	M	900	EL	...	.....	.....	.....	.....	.....	.....	58
CE	21.6	52.2	16.9	38.6	337.8	WS,TB	WS,TB	Re	0.15	115.5	14.2	4	DB	.....	.....	.....	D,V	M	.....	.....	...	.....	.....	D,V	M	.....	.....	59
CE	19.2	64.2	10.5	18.2	126.8	WS,TB	WS,TB	.....	0.15	65	15.6	16	DB	1	242	AS	V	Mp	600 350	WE	1	392	SW	D	Mp	1500 800	WE	60
RS	29.3	80.0	22.0	15.0	314.2	WS	WS	Re	9.5	91	14.5	16	DB	2	245	AS	Hy	.....	1500	EL	N	.....	.....	.....	.....	.....	.....	61
RS	12.7	28.6	26.2	7.0	173.6	By	By	Re	25	40.5	17.7	8	DB,Pd	1	863	AS	Hy	M	1500	AC	N	.....	.....	.....	.....	.....	.....	62
BW	12.1	.....	.....	12.7	114	WS	WS,FG	Re	10	30.8	.....	3[10]	ST,Pd	2	88.5	SW	V	M	1000	AC	...	.....	.....	.....	.....	.....	.....	63
BW	16.9	52.4	22.8	16.1	76.3	WS,No	WS,EA	Re	.....	80.6	13.3	18	DB	2	162	SW	D,V	M	450	GE	2	680	SW	D,V	M	700	GE	64
CE	18.6	.....	.....	19.7	120.8	WS,TB	WS,TB	Re	10.2	47	22.7	4[9]	Pd	2	145	SW	D,V	M	600	LAC	N	.....	.....	.....	.....	.....	.....	65
CE	18.6	27.0	6.9	19.8	89.0	WS,TB, FG	WS,TB	Re	25	47	24	32	Pd	1	300	WE	V	Mp	300 1250	.....	N	.....	.....	.....	.....	.....	.....	66
BW	12.4	38.8	23.0	22.0	300.0	.....	.....	.....	52.5	37.7	.....	3[10]	.....	2	110	WE	.....	.....	1500	GE	N	.....	.....	.....	.....	.....	.....	67
CE	13.1	13.0	.....	26.4	93.0	WS,TB	.....	Re	7.0	33.4	25.8	1	DB,Pd	1	182	SW	V	Mp	900	AC	...	.....	.....	.....	.....	.....	.....	68
BW	9.2	6.7	.....	.....	.....	WS	.....	Re	60	6.7	41.7	1[10]	ST,Pd	1	284	WE	D	Du	1000	WE	N	.....	.....	.....	.....	.....	.....	69
BW	2.4	.....	.....	.....	.....	.....	.....	.....	.....	0.6	53	.....	Pd	1	.....	GF	D	M	.....	.....	...	.....	.....	.....	.....	.....	.....	70
BW	3.3	.....	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	Pd	1	.....	CF	V	M	.....	.....	N	.....	.....	.....	.....	.....	.....	71
BW	.....	.....	.....	.....	.....	WS,FG	WS	Re	.....	.....	.....	.....	DB	2	.....	SW	V	M	.....	WE	2	.....	SW	S,Hy	M	.....	WE	72
BW	26.5	33.5	12.8	32.2	103.2	WS,FG	WS,FG	Re	7.6	51.2	32.4	16	Pd	2	222	.....	V	M	.....	.....	...	.....	.....	.....	.....	.....	.....	73
RS	41.4	52.4	40.8	19.8	391.4	WS,By	D	Re	13.1	63.9	27.7	16	Pd	2	780[6]	SW	V	M	1250	EM	N	.....	.....	.....	.....	.....	.....	74
RS	34.0	21	.....	.....	71.5	WS	.....	Re,Pl	0.1	34.4	15.0	6	DB	1	160	SW	D,Hy	M	600	WE	1	255	SW	D,Hy	M	700	WE	75
RS	26.7	16.5	.....	.....	89.4	WS	.....	Re	0.10	.....	14.1	6	DB	1	609	CF	V	M	400	WE	1	705	CF	D	Mp	900/450	WE	76
CE	7.9	12.3	N	16.8	68.8	WS,TB	.....	Tu	-0.10	27.6	19.4	12	DB	2	67.8	SW	V	M	200	GE	2	104	SW	V	M	300	GE	77
RS	14.8	10.2	.....	.....	32.0	WS	.....	.....	0.10	16.45	17.32	4	DB	1	81.8	CF	S,V	.....	200	AC	1	124	CF	Mp	Du	400	EM	78
BW	16.0	.....	.....	.....	.....	Cool	.....	Re	-0.3	11.3	.....	6	DB	1	279[4]	WE	D	M	150	WE	1	318.5[4]	WE	D	M	250	WE	79
BW	11.0	3.0	.....	.....	.6	FG	.....	Tu	0.10	.....	24.5	.....	DB	1	113.5	AS	S,D	Mp	75	GE	1	131.5	AS	S,D	Mp	100	GE	80
EC	8.6	2.5	.....	4.4	.....	Cool	.....	.....	.....	.....	0.7	.....	.....	1	38	AS	D	Mp	50	GE	1	38	AS	.....	Mp	150	GE	81
EC	13.6	5.1	.....	9.0	.....	.....	.....	.....	0.15	6.5	26.1	4	DB	1	44.3	AS	D	M	40	EM	1	70.5	AS	D	Mp	200/100	EM	82
EC	13.6	5.1	.....	9.0	.....	.....	.....	.....	0.15	6.5	26.1	4	DB	1	44.3	AS	D	M	40	EM	1	70.5	AS	D	Mp	200/100	EM	83
RS	16.8	.....	N	N	32	WS	.....	Re	.....	14.3	18.9	4	DB	1	46	WE	S,D,V	Du	200	WE	1	64.4	WE	.....	Du	300	WE	84
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	85
K	3.9	.....	.....	.....	.....	.....	.....	.....	.....	1.9	35	.....	BD	1	.....	SW	D	M	.....	GE	1	.....	CF	D	M	.....	GE	86
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	87

CF - Clarage Fan Co
CH - Chicago Heater Co
CHW - C H Wheeler Mfg Co
CW - Clyde Iron Works
COC - Cochrane Corp
CV - Copes-Vulcan Div, Blaw-Knox Co
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp
DSC - Detroit Stoker Co
EC - Erie City Iron Works
EL - Elliott Co
EM - Electric Machinery Mfg Co
FE - Fairfield Engineering Co
FW - Foster Wheeler Corp
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GR - Griscom-Russell Co
GW - Graver Water Conditioning Co
HCC - Hagan Chemicals & Controls, Inc
HL - Heil Laboratories
HR - Hewitt Robins Inc
IB - Industrial Brownhoist Corp
IN - Infilco Inc
IR - Ingersoll-Rand Co
IW - Illinois Water Treatment Co
JM - Jeffrey Mfg Co
JW - Jarvis B Webb Co
K - E Keeler Co
KC - Koppers Co
LAC - Louis Allis Co
LB - Link-Belt Co
LN - Lunde & Northrup Co
LS - Lackawanna Stoker Co
MCH - McNeely Pittsburg
ML - Manning & Lewis Engrg Co
MS - Maryland Shipbuilding & Drydock Co
NA - National Aluminate Corp
PIC - Pland Corp
PM - Permutit Co, Div Pfaudler Permutit
PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc
RCA - Radio Corporation of America
RF - Republic Flow Meters Co
RHE - Ross Heat Exchanger Div
RO - Robbins & Meyers, Inc
RS - Riley Stoker Corp
SA - Stephens-Adamson Mfg Co
SW - Sturtevant Div, Westinghouse Electric Corp
UC - United Conveyor Corp
WE - Westinghouse Electric Corp
WO - Worthington Corp
WP - Western Precipitation Corp
YU - Yuba Heat Transfer Div

Central-station installations TABLE 2 continued

Project Number	BOILER FEED PUMPS							FUELS								FIRING											
	Capacity each, gpm	Discharge pressure, psig	Manufacturer	Flow control	Drive	Drive hp	Drive manufacturer	Fuel type	Heating value 1000 Btu per lb	Ash fusion temperature, F	Fuel delivery method	Coal unloading system	Unloading system manufacturer	Handling system to storage	Handling system manufacturer	Coal firing equipment	Firing equipment manufacturer	No. pulverizers per boiler	Ash-handling system	Ash-handling system manufacturer	Soot blower type	Soot blowing medium	Soot blower manufacturer	Dust collector type	Dust collector manufacturer	Stack height, ft	
48	1010	2290	AC	Hy	2M	1750	EL	C	.....	.....	RR	CS	.....	Co,Bu	.....	P	CE	4	Hyd	.....	Ro,Ret	Air	.....	Me	.....	250	
49	1230	2450	DL	R	2M	2000	GE	C	13.1	2250	RR	CS	SA,FE	Co	FE	Cy	.....	..	Pn,Hyd	.....	Ro,Ret	St	DP	El	.....	250	
50	1140	2280	WO	Hy	2M	2000	WE	C,O	13.5	2200	RR	CS	HR	Bu	SA	P	CE	4	Pn	UC	Sta,Ret	St	CV	El	WP	335	
51	2040	2241	AC	R	2M	3000	GE	C	10.5	1900	RR,Tr	CS	HR	Co,Bu	LB	P	CE	4	Pn,Hyd	UC	Ret	Air	DP	El	AS	503	
52	960	2180	IR	Hy	2M	1750	EL	C,G	10.4	2000	RR,Pl	CS	FE	Bu	FE	P	CE	4	Hyd	UC	Ret	Air	DP	Me	GF	342	
53	.....	.....	.....	.....	.....	.....	.....	C	9.5	.....	RR,Tr	.....	.....	.....	.....	Cy	.....	..	.....	.....	Ret	Air	.....	Me	.....	.....	
54	.....	.....	.....	R	2M	.....	.....	C,G	12.5	2000	RR	CS	.....	Co	.....	Cy	.....	..	.....	.....	Ret	Air	DP	.....	.....	.....	
55	.....	.....	.....	IR	R	2M	2500	GE	C	.....	.....	RR	CS	.....	Co	.....	P	CE	4	Pn	UC	Ret	Air	CV	N	.....	.....
56	1500	2100	AC	Hy	2M	2500	AC	C,G	11.8	1900[22]	RR	CS	HR	Sc	HR	P	CE	4	.....	.....	Ret	St	CV	El	RC	257	
57	1274	2330[24]	BJ	.....[16]	2M	2250	GE	C	11.2	2450	Ba;RR	CS,Cl	C1W	Co,Bu	LB,HR	Cy	PC	..	Hyd	UC	Ro,Ret	St	CV	El	KC	215	
58	1300	2290	PP	Hy	2M	2500	EL	G	1080[18]	.....	Tr Pl	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
59	.....	.....	.....	R	.....	.....	.....	O,C-s	9.5	2140	Co	.....	.....	Co,Bu	.....	P	CE	4	Pn,Hyd	.....	Ro,Ret	St	CV	Me	.....	200	
60	875	1790	IR	R	3M	1250	WE	C	11.0	1950	RR	CS	RO	Co	LB	P	CE	4	Hyd	UC	Ro,Ret	Air	DP	Mo	WP	250	
61	1500	2232	IR	R	2M	2250	EL	C	10.6	2050[22]	Tr	.....	.....	Bu	Ex	P	CE	4	Hyd	.....	Ret	Air	DP	Mo	WP	450	
62	625	1905	IR	Hy	2M	1000	AC	O,G	18.5	.....	Tr	.....	.....	.....	.....	.....	.....	.....	Hyd	SA	Ret	St	DP	.....	.....	143	
63	665	1775	IR	R	3M	900	AC	C-s,G	9.1	2100	RR,Pl	CS	LB	Co,Bu,Sc	LB	Cy	.....	..	Hyd	UC	Ro,Ret	St	DP	.....	N	188	
64	1650	1880	BP	R	2M	2250	GE	C-s	6.8	2200	Tr	Hop	McN	Bu,Sc	McN	P	BW	6	Pn,Hyd	UC	Ret	Air	DP	Mo	WP	250	
65	1686	1509	WO	S,Hy	2M	2000	LAC	G	1000[18]	.....	Pl	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70
66	950	.....	PP	Hy	2M	1500	.....	G	1080[18]	.....	Pl	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	145
67	.....	.....	.....	.....	.....	.....	.....	C	11.4	2126	Ba	.....	.....	Co,Sc	FE	Cy	.....	..	Hyd	UC	Ro,Ret	Air	DP	N	.....	353	
68	760	1600	AC	R	2M	1030	AC	O,G	1100[18]	.....	Pl	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	157
69	250	1100	AC	.....	2M	250	AC	C-s	8	2160	RR	CS	.....	Co	HR	Cy	.....	..	Hyd	UC	Ro	St	DP	Mo	BU	200	
70	.....	.....	IR	R	M	.....	WE	O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	.....	DP	.....	.....	.....	
71	.....	.....	PP	.....	M	GE	O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	N	.....	.....	St	DP	N	.....	.....	
72	.....	.....	PP	Hy	3M	2000	WE	O	18.0	.....	Ta	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	St	.....	.....	.....	125	
73	2620	2700	.....	R	.....	4000	.....	G,O	1079[18]	.....	Pl,RR	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	166
74	1323	2201	PP	Hy	2M	2700	EM	G,O	1080[18]	.....	Pl,RR	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	125
75	900	1625	BJ	R	2M	600	WE	G,C	1080[18]	.....	Pl,RR	CS	McN	Co,Bu,Sc	McN	P	RS	3	Hyd	UC	Ro,Ret	St	CV	Mo	RC	200	
76	990	1550	.....	Hy	2M	1000	.....	L,G	8.5	2200	RR,Tr	.....	.....	Co,Sc	.....	P	RS	3	Hyd	.....	Ro,Ret	St	CV	Mo	RC	112	
77	1067	1675	PP	N	2M	1250	EL	C	12.8	2500	RR	Cr	IB	Cr	PIC	P	CE	3	Pn	ASH	Ro,Ret	Air	CV	El	WP	164	
78	600	1150	BP	.....	2M	600	GE	C	12.1	2470	CSU	.....	.....	.....	.....	P	RS	4	Hyd	UC	Ret	St	CV	Mo	RC	200	
79	300	1100	AC	R	2M,LT	250	AC	O,G	18.0	.....	Tr,Pl	.....	.....	.....	.....	.....	.....	.....	.....	.....	Ro,Ret	St	.....	.....	.....	200	
80	160	1095	PP	R	2M	150	WE	C	13.1	2200	RR	TH	.....	Bu	JM	CG	BW	..	Pn	.....	Ro,Ret	St	DP	.....	.....	.....	
81	190	820	IR	R	2M	125	GE	C	9.3	2280	RR,Tr	Dump	FE	Co,Bu	.....	SS,TG	EC	..	Pn	UC	Ro	St	CV	Mo	WP	.....	
82	250	775	PP	R	2M	200	EM	C,O	11.3	2110	Ba	.....	.....	Co,Bu	JW	SS,TG	DSC	..	Hyd	UC	Ro	Air	CV	Mo	AS	160	
83	250	775	PP	R	2M	200	EM	C,O	11.3	2110	Ba	.....	.....	Co,Bu	JW	SS,TG	DSC	..	Hyd	UC	Ro	Air	CV	Mo	AS	160	
84	633	650	WO	R	1M,LT	300	GE	C,O,G	13.4	2200	RR,Tr, Pl	CS	.....	Co	.....	P	RS	4	Pn	UC	Ro,Ret	St	DP	Mo	WP	225	
85	.....	.....	.....	.....	.....	.....	.....	C	.....	.....	RR,Tr	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....
86	.....	.....	.....	.....	.....	.....	.....	C	10.0	2200	Tr	.....	.....	.....	.....	CGS	LS	..	Pn	UC	.....	St	CV	N	.....	.....	
87	.....	.....	.....	.....	.....	.....	.....	C	11.4	.....	RR,Tr	CS	.....	Co	.....	UF	.....	..	Hyd	.....	Ro,Ret	St	.....	Mo	.....	.....	

SYMBOLS USED ABOVE

Ad - Admiralty
AdB - Admiralty Brass
AdI - Admiralty, Inhibited
AlB - Aluminum Brass
AsAlCu - Arsenical Aluminum Copper
AsCu - Arsenical Copper
Ba - Barge
Br - Brass
Bu - Bulldozer
C - Coal, bituminous
CG - Chain grate stoker
Cl - Clam
Co - Conveyor
Cr - Crane
CS - Car shaker
C-s - Coal, sub-bituminous
CSU - Cargo self unloader
Cy - Cyclone
De - Deaerator
Dump - Dumper
El - Electrostatic
Ev - Evaporator
Ex - Existing equipment
G - Gas
H - Heater
Hy - Hydrogen
HC - Hollow conductor
Hop - Bump hopper
Hot - Condenser hotwell
Hy - Hydraulic coupling
Hyd - Hydraulic
J - Steam jet
L - Lignite
LI - Liquid
M - Motor drive
Me - Mechanical
Mp - Two motors per fan
N - None
O - Oil
P - Pulverizer
PAd - Phosphorized Admiralty
Pl - Pipeline
Pn - Pneumatic
R - Regulator
Ret - Retractable
Ro - Rotary pump or blower
RR - Railroad
S - Speed control
SC - Single cylinder
Sc - Scraper
So - Softener
SS - Spreader stoker
St - Steam
Sta - Stationary
T - Turbine drive
Ta - Tanker
TC - Tandem compound
TG - Traveling grate
TH - Track hopper
Tr - Truck
UF - Underfeed stoker
16 - Off-on, with minimum flow bypass
17 - At 0.5 in Hg
18 - Btu per cu ft
19 - Of existing plant condensate
20 - Atmosphere
21 - Preferred standard
22 - Softening temperature
23 - Double flow
24 - Differential pressure

	HEATER					CONDENSER								TURBINES									CONTROLS					
Number	Number	High pressure heater exit temperature, F	Max Deaerating press, psia	Manufacturer	Description	Surface, 1000 sq ft	No. water passes	Tube material	Air removal	Manufacturer	Feedwater treatment (raw water)	Feedwater pH	System manufacturer	Number	Capability each, 1000 kw	Turbine type	Manufacturer	Exhaust pressure, psia	No. of bleedpoints	No. main turbine exhausts	Main generator voltage, kv	Generator rating, 1000 kva (max)	Generator cooling	Combustion control manufacturer	Feedwater control manufacturer	Closed-circuit TV manufacturer	Total boiler capacity including new units, 1000 lb per hr	Total generator capability including new units, 1000 kw	Point Number
5	390	87.4	GR	H	65	2	AsCu	.....	WO	De	.....	.....	1[5]	110	TC	WE	1.75	5	1	13.8	134	H_2	BM	BM	N	800	110	48
5	453	125	YU, GW	H	62.5	...	AlB	J	IR	De	10	.....	1[5]	125[20]	TC	GE	1.75	6	1	15	160	H_2	.....	.....	N	927	136	49
6	499	101.7	GR	H	75	1	AlB	J	WO	De	9.0	COC	1	150	TC	GE	0.75	6	3	18	147[17]	H_2	BM	BM	N	4280	624.5	50
6	448	.....	GR	Hat	65	2	Ad1	J	AC	De	9.2	IN	1[21]	125	TC	GE	1.75	6	2	16.5	160	H_2	LN	BM	.....	850	125	51
6	444	98.6	AP	H	72.5	2	PAd	J	FW	De[19]	8.8	COC	1[21]	125	TC	GE	0.5	5	2	15	160	H_2	HCC	HCC	N	2268	262	52
...	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	1	144	TC	WE	1.0	5	...	16	160	H_2, HC	.....	.....	.....	1045	144	53
6	.....	.....	.....	.....	.....	...	.....	J	.....	De	.....	.....	1	150	TC	GE	0.75	6	2	.....	173	H_2	.....	.....	.....	1000	150	54
6	518	.....	CHW	Hat	95	2	Ad	J	CHW	De	8.8	.....	1[5]	175	TC	WE	0.75	6	1	16.0	176	GC	BM	BM	.....	.....	356	55
6	446	120	AS	H	100	2	Ad1	J	AS	De	9.0	.....	1	156	TC	GE	1.75	6	2	18	192	H_2	BM	BM	N	3928	480	56
6	462	24.2	AOS, EL	H, Hat	75	2	Ad	.....	AIS	De, Sa, Ev	8.7	IW, COC, YU	1	165	TC	GE	1.75	6	2	18	192	H_2	BM	BM	N	1760	252	57
6	450	112	GR, WO	H	80	2	Ad1	J	WE	De	.....	.....	1	160	TC	GE	1.75	6	1	20	192	H_2, HC Li	.....	.....	.....	1100	160	58
7	460	114	WE	H	70	2	Ad	J	AC	De	.....	.....	1	150	TC	GE	1.75	7	2	18	192	H_2	.....	.....	.....	1200	150	59
5	454	82.7	YU, AP COC	H, Hat	50	2	AsAlCu	J	YU	Sa, Ev	8	PM	1[21]	105	TC[23]	GE	1.75	5	2	13.8	107	H_2	LN	BM	.....	3260	377	60
5	473	55.3	GR, GW	H	75	2	Ad1	J	WO	De	9	Ex	1	156	TC	WE	0.75	5	1	18.0	192	.....	.....	.....	.....	3000	450	61
5	447	395.6	GR	H	45	2	Ad	Ba	IR	De	.....	IW	1[21]	75[20]	TC	GE	0.75	5	2	13.8	94	H_2	.....	.....	.....	765	109	62
5	460	72	WE	H	55	2	Ad	J	WE	De	.....	COC, IW	1	82.5	TC	AC	0.75	5	1	13.8	96	H2	RF	RF	.....	1200	150	63
5	392	66	EL	H	50	2	AsAd	J	IR	De, Ev	.....	HT	1[5,21]	100	TC	GE	1.75	5	1	13.8	118	H_2	HCC	HCC	RCA	1500	.....	64
...	.....	.....	.....	H	.....	...	.....	J	.....	Sa, Ev	.....	.....	1[21]	100	SC	WE	0.75	5	2	13.8	133.7	H_2	BM	BM	AD	800	112.5	65
5	465	25	YU, GW, AOS	H, Hat	55	2	.....	J	AC	De	9.0	.....	1	100	TC	AC	1.75	5	1	13.8	134	H_2	.....	.....	.....	1950	278	66
4	452	70.3	YU, GR	H	55	2	AsAd	J	WE	De	.....	AIR	1[21]	100	TC	WE	0.5	4	1	13.8	107	H_2	BM	BM	N	1400	200	67
5	490	66.3	AC	H	55	2	Ad	J	AC	Ev	.....	NA	1[21]	66	TC	WE	0.75	5	2	13.8	88.2	H_2	BM	BM	.....	1570	200	68
4	374	30.9	GR	H	19	2	Ad	J	AC	De	.....	COC	1[21]	22	SC	AC	0.75	4	1	13.8	.....	H_2	BM	BM	.....	230	24.2	69
...	.....	.....	.....	.....	.....	...	.....	.....	.....	De	.....	.....	.....	.....	.....	.....	.....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	70
...	.....	.....	.....	.....	.....	...	.....	.....	.....	So	.....	.....	.....	.....	.....	.....	.....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	71
6	.....	100	WE	.....	97.5	2	AlB	J	CHW	Ev	8.3	.....	1	142	TC	AC	0.75	6	1	...	176	H_2	BM	BM	AD	.....	323	72
6	460	119.1	.....	H	109	2	Ad1	Ba	AC	De	10.8	.....	1	165	TC	AC	1.25	6	1	18	209	H_2, HC	.....	.....	.....	2440	329	73
6	498	67	WE, GW	H, Hat	90	2	AsCu	J	IR	Sa, Ev	9.0	.....	1[5]	165	TC	GE	1.75	6	2	18	192	H_2	BM	BM	DP	2700	375	74
5	415	70	RHE	H, Hat	35	2	Ad	J	AIS	De	8.8	COC	1[21]	44	TC	WE	0.75	5	1	13.8	58.8	H_2	BM	BM	.....	840	88	75
5	418	64	.....	H	40	2	Ad	J	WO	Sa, Ev	.....	.....	1[21]	46	TC[23]	WE	0.75	5	2	13.8	47.1	H_2	.....	.....	.....	775	70	76
5	432	63.6	AC, YU	H	35	2	Ad	J	WE	De	8.5	BI	1[21]	50	TC	GE	0.75	5	1	13.8	58.8	H_2	BM	BM	.....	1090	197	77
4	356	.....	WE	H	18	2	.....	J	CHW	.....	.....	HL	1[21]	29.6	SC	GE	14.0	4	1	12.5	22	H2	RF	RF	.....	520	48.5[20]	78
4	390	65	WE	H	20	2	Ad	J	WE	De	7.6	PM	1[21]	22	SC	WE	1.0	4	1	12.5	29.4	H_2	BM	BM	.....	600	57.8	79
3	410	875	ML	Hat	7.6	2	Ad	J	AC	De	6.9	PM	1	7.5	SC	AC	1.75	3	1	4.2	9.4	Air	HCC	.....	.....	16	12.5	80
2	293	72	.....	H, Hat	7.5	2	Ad	J	WO	Sa, Ev	.....	.....	1[21]	7.5	SC	WE	.....	3	1	13.8	8.3	Air	RF	RF	.....	137	14	81
3	315	45	RHE, CH	H	10	2	Ad1	J	WO	Sa, Ev	8.0	.....	1	9.4	SC	EL	0.75	3	1	12.5	12.5	Air	BM	BM	.....	250	18.8	82
3	315	45	RHE, CH	H	10	2	Ad1	J	WO	Sa, Ev	8.0	.....	1	9.4	SC	EL	0.75	3	1	12.5	12.5	Air	BM	BM	.....	250	18.8	83
...	300	10	.....	H	N	...	.....	.....	.....	De	7	IN	N	.....	.....	.....	.....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	84
...	.....	.....	.....	.....	10	2	AdB	J	AC	.....	.....	.....	1[21]	10	SC	WE	0.5	3	1	12.5	12.5	.....	.....	.....	.....	250	25.5	85
...	.....	.....	.....	.....	3.5	2	Ad	J	WE	So	.....	PM	1	2.5	.....	WE	14.0	1	...	.....	.....	.....	.....	.....	.....	52.5	.....	86
3	.....	.....	.....	.....	.....	2	Br	J	.....	Ev	.....	.....	1[21]	20	SC	EL	.....	...	...	.....	.....	H_2	.....	.....	.....	.....	.....	87

These footnotes are for Nuclear Survey on following page.

MANUFACTURERS

AC - Allis-Chalmers Mfg Co
ACF - ACF Industries, Inc
AEC - U S Atomic Energy Commission
AECL - Atomic Energy of Canada, Limited
AGC - Aerojet General Corp
AI - Atomics International
Alco - Alco Products, Inc
ANL - Argonne National Laboratory
AOS - A O Smith Corp
APDA - Atomic Power Development Associates, Inc
B&R - Burns & Roe, Inc
B&W - Babcock & Wilcox Co, Inc
Bechtel - Bechtel Corp
CA - Commonwealth Associates
ECNG - East Central Nuclear Group, Inc
FW - Foster Wheeler Corp
FWCNG - Florida West Coast Nuclear Group
GA - Gilbert Associates
GDC - General Dynamics Corp
GE - General Electric Co
GRC - Griscom-Russell Co
HW - H K Ferguson Co
HTRDA - High Temperature Reactor Development Associates
LASL - Los Alamos Scientific Laboratory
Martin - Martin Co
NRTS - National Reactor Testing Station, Idaho
ORNL - Oak Ridge National Laboratory
PKS - Peter Kiewit Sons, Co
PRDC - Power Reactor Development Co
PS&E - Pioneer Service & Engineering Corp
S&L - Sargent & Lundy
S&W - Stone & Webster Engineering Corp
SS - Stainless steel
Vitro - Vitro Engineering Corp
West - Westinghouse Electric Corp

SYMBOLS

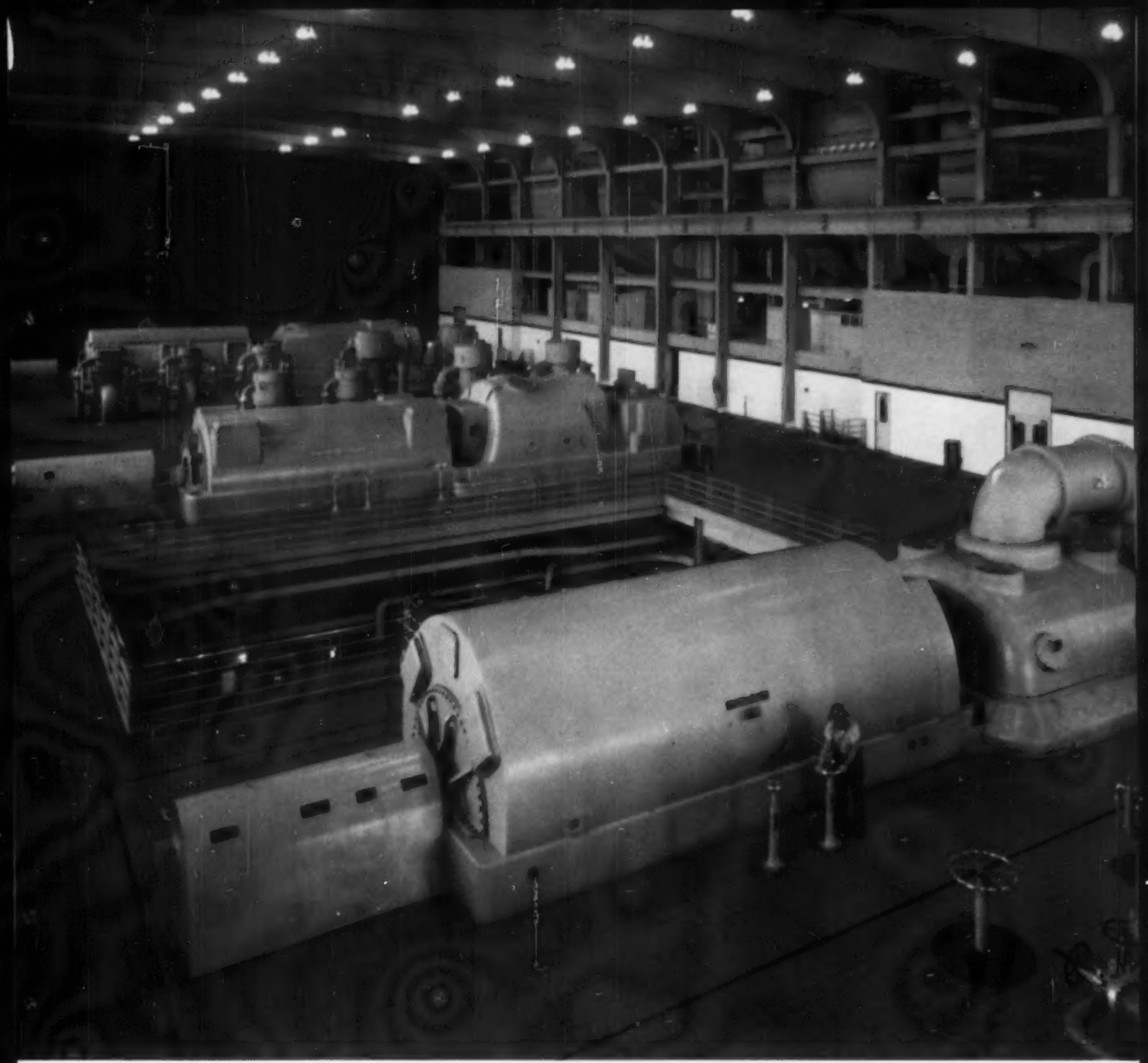
a - Proposed
b - No load
c - Full load
d - Initial
e - Oil-fired superheater supplies 112 mw of this total
f - Met of space heating
g - Approximate
h - AEC Power Demonstration Program
i - Pressure-tube reactor
j - 20 mwt design; 61.7 mwt on test
k - With new core being installed
l - To test nuclear superheating
m - Average
n - Reactor only plus 5-yr fuel charges. Reactor fuels, existing turbines
o - Design
p - Based on 90 mwt capacity
q - At 30 mwt
r - Nuclear Power Group paying $25 million for R & D
s - 4.2 mwe from coal-fired superheater
t - Central Utilities Atomic Power Assoc paying $3.6 million for R&D
u - 12 mwe from nuclear superheating
v - Superheating section has 93%-enriched UO_2-SS cermet
w - Guaranteed
x - Expected
y - Ultimate after 4-5 years
z - Met for space heating
1 - Blanket of depleted-U pins
2 - APDA paying $14 million for R&D
3 - Blanket: 0.4% enriched U-Mo sodium-bonded in SS tubes
4 - Primary pressure
5 - Secondary pressure
6 - For second core, excluding R&D costs
7 - Excluding R&D costs
8 - Gas turbine components being developed at Fort Belvoir, Va
9 - With cooperation of Hydro-Electric Commission of Ontario and Canadian General Electric Co
10 - Gas flow, 1000 lb per hr

Survey of stationary nuclear power plants

Compiled by: B. G. A. Silvestri, Associate Editor

Reactor power plant	Owner and operator	Location	Electrical capacity, mwe	Reactor thermal capacity, mwt	Year of first load operation	Reactor fuel	Moderator	Coolant	Coolant temperature, in and out, F	Coolant pressure, psig	Steam pressure, psig	Steam temperature, F	Steam flow, 1000 lb per hr	Reactor system builder	Architect-engineer	Steam generator manufacturer	Total plant cost, millions $	Overall energy cost, mills per kwhr
PRESSURIZED WATER REACTORS																		
Shippingport Atomic Power Station	AEC; Duquesne Light Co	Shippingport, Pa	66 150[a]	236 520[a]	1957 1960	90% U235 seed Nat UO_2 blanket	Light water	Light water	510 540	1985	870[b] 585[c]	Saturated	861	West	S&W B&R	B&W FW	75.0	64.4
Yankee Atomic Electric Company	Yankee At Elec Co; (AEC Pwr Dem Prog)	Rowe, Mass	120[d] 185	392[d] 602	1960	3.4% enriched UO_2 pellets	Light water	Light water	467 535	1965	500	470	1800	West	S&W	West	53.1	12 to 14
Indian Point	Consolidated Edison Company of N Y., Inc	Buchanan, N Y	275[e]	585	1961	93% enriched UZr; ThO_2 blanket	Light water	Light water	488 510	1485	355	1000	1900	B&W	Vitro	B&W	100	14.3
Army Package Power Reactor	Army Corps of Engr; Alco Products, Inc	Fort Belvoir, Va	1.9	10	1957	Highly enriched UO_2-SS plates	Light water	Light water	431 490	1185	400[b] 185[c]	407[c]	34	Alco	S&W	Alco	6.3	.....
Army Package Power Reactor	Army Corps of Engr	Fort Greely, Alaska	1.7 12.5[f]	20	1960	Highly enriched UO_2-SS plates	Light water	Light water	431 490	1185	400[b] 185[c]	407[c]	70	Alco	PKS	Alco	5.4	.....
Modular package power plant	AEC and U.S. Air Force	Sundance, Wyo	1 0.2[g]	8-10[g]	1961	Enriched metallic U	Light water	Light water	.....	.....	.....	Saturated	.....	Martin	.....	.....	5.4	.....
Saxton	General Public Utilities	Saxton, Pa	12	20	1961	3-5% enriched UO_2 pellets	Light water	Light water	540[m]	1185	900[b] 600[c]	Saturated	70	West	GA	.....	6.3[n]	.....
Parr Shoals[i,h]	Carolinas-Virginia Nuclear Power Assoc	Parr Shoals, S C	19	62	1962	Slightly enriched UO_2 pellets	Heavy water	Heavy water	555[m]	1485	660	725	281	West	S&W	.....	19.4	.....
Remote frigid site	Army Corps of Engr	Camp Century, Greenland	1.5 0.3[j]	10	1960	93.5% enriched UO_2-SS plates	Light water	Light water	522 500	1735	450	Saturated	.....	Alco	.....	Alco	3.2	.....
Southern California Edison Company	Southern California Edison Company	California	360	1130	1964	Low enriched	Light water	Light water	567	2130	2700	680	4500	West	.....	.....	70	7.3
BOILING WATER REACTORS																		
Bonus	AEC; Puerto Rico Water Resources Board	Punto Higuera, Puerto Rico	17	50	1962	1.8% enriched UO_2	Light water	Light water	550	900	850	900	.....	.....	.....	.....	14.5	.....
Experimental Boiling Water Reactor	AEC Argonne National Lab	Lemont, Ill	5	61.7[i] 100[k]	1956	1.44% enriched U plates	Light water	Light water	479	600	560	Saturated	61[o]	ANL	S&L	.....	4.6[p]	35[p]
Borax-V[l]	AEC Argonne National Lab	NRTS, Idaho	2	20	1960	.....	Light water	Light water	525	600	550	525	.....	ANL	ANL	.....	.....	.....
Vallecitos Boiling Water Reactor	General Electric Co; Pacific Gas & Elec. Co	Vallecitos, Calif	5	50	1956	93% enriched UO_2-SS plates	Light water	Light water	545	1000	1000	545	96[q]	GE	Bechtel	.....	3.0	.....
Dresden Nuclear Power Station (dual cycle)	Commonwealth Edison Co; NPC[r]	Dresden, Ill	180	626	1959	1.5% enriched UO_2 pellets	Light water	Light water	547	1000	960[s] 460[t]	540[s]	1400[s] 1280[t]	GE	Bechtel	.....	45.0	9.0 to 7.5[s]
Elk River (closed cycle)[h]	AEC; Elk River Rural Coop Pwr Assoc	Elk River, Minn	22[u]	58.2	1960	90-4% enriched UO_2 in ThO_2 pellets	Light water	Light water	536	950	930[s] 715[t]	535[s] 504[t]	250[s] 225[t]	AC	S&L	.....	11.7	12.6
Pathfinder (nuclear superheat & controlled recirculation)[h]	Northern States Pwr Co[l]	Sioux Falls, S D	66[u]	203	1962	1.8% enriched UO_2 pellets[v]	Light water	Light water	489	600	540	825	619	AC	PS&E	.....	22.6	.....
Humboldt Bay (steam suppression to limit containment)	Pacific Gas and Electric Co.	Humboldt Bay, Calif	50[w] 69[x]	165[w] 197[x]	1962	2% enriched UO_2 pellets	Light water	Light water	545	1000	545	1000	560	GE	Bechtel	.....	20	8.5
Big Rock Point (forced circulation)	Consumers Power Co	Big Rock Point, Mich	50 75?	156 240	1962	3.9% enriched UO_2 pellets	Light water	Light water	545-	1000-1450	545-	1450	606	GE	Bechtel	.....	26.7	11 to 14
Stationary Low Power Plant No. 1 (SL-1)	AEC; Combustion Engineering, Inc	NRTS, Idaho	0.2 0.4[z]	3.0	1958	93% enriched UAlNi plates	Light water	Light water	420	300	420	380	9	ANL	.....	.....	.....	.....
Los Angeles, Pasadena, Calif	AEC; Los Angeles, Pasadena, Calif	Los Angeles, Calif	54	174	1963	Low enriched UO_2 pellets	Light water	Light water	549 307	1040	1040	549	637	GE	.....	.....	20	.....
FAST BREEDER REACTORS																		
Experimental Breeder Reactor No. 1	AEC; ANL	NRTS, Idaho	0.14	1.4	1951	93% U235 seed Nat U blanket	None	NaK	442 600	15	400	525	5.6	ANL	Austin	ANL	2.7	.....
Experimental Breeder Reactor No. 2	AEC; ANL	NRTS, Idaho	20	62.5	1960	49% enriched U-fission pins[3]	None	Sodium	720 900	100	1250	850	200	ANL	H&K	AOS	29	.....
Enrico Fermi Atomic Power Plant[h]	PRDC; Detroit Edison Company[2]	Lagoona Beach, Mich	100	300	1960	25.6% enriched U-Mo pins[3]	None	Sodium	800	127	600	748	960	PRDC	CA	GRC	54.9[y]	.....
SODIUM-GRAPHITE REACTORS																		
Sodium Reactor Experiment	AEC; Atomics International	Santa Susana, Calif	7.5	21	1957	2.8% enriched U slugs	Graphite	Sodium	500 960	0	600	825	60	A I	A I	B&W	6.4	.....
Hallam[h]	AEC; Consumers Pub Power Dist of Neb	Hallam, Neb	81	254	1962	2.5% enriched U-Mo-SS plates	Graphite	Sodium	500 925	10	800	825	730	A I	Bechtel	GRC	41.3	10 to 11
ORGANIC MODERATED REACTORS																		
Organic Moderated Reactor Experiment	AEC; Atomics International	NRTS, Idaho	0	16	1957	90% enriched U plates	Santowax	Santowax	500 700	300	None	None	None	A I	A I	.....	2.5	.....
Piqua Municipal[h]	AEC and City of Piqua, Ohio	Piqua, Ohio	10.5	46	1961	1.8% enriched U-Mo plates	Terphenyl	Terphenyl	533 617	120	450	550	150	A I	.....	.....	15.3	10 to 11
GAS COOLED REACTORS																		
Gas-cooled reactor experiment[8]	AEC and Aerojet-General Corp	NRTS, Idaho	.....	2	1959	Highly enriched UO_2 plates	Light water	Nitrogen	1150 out	200+	.....	.....	66[10]	AGC	.....	.....	.....	.....
Gas-cooled reactor	AEC; Oak Ridge National Labs	Oak Ridge, Tenn	29	84	1962	2.6% enriched uranium	Graphite	Helium	1050	315	1310	900	255	AC	.....	.....	3.0	25
Peach Bottom[h]	Philadelphia Elec Co., HTRDA	Peach Bottom, Pa	46	115	1963	Enr UC_2-ThC_2 in graphite	Graphite	Helium	1300	300	1450	1000	367	GDC	Bechtel	.....	24.5	.....
ECNG & FWCNG[h,i]	FWCNG & ECNG	Pierce, Florida	97.3	153	1963	Low enriched UO_2	Heavy water	Gas	1050 out	520	1490	950	390	.....	.....	.....	38.9	.....
HOMOGENEOUS REACTORS																		
Homogeneous Reactor Experiment-2	AEC; Oak Ridge National Laboratory	Oak Ridge, Tenn	0.3	5.2	1957	UO_2SO_4 solution in D_2O	Heavy water	Heavy water	572	2000	520	471	16.7	ORNL	.....	.....	.....	.....
CANADIAN REACTOR																		
Nuclear Power Demonstration[i]	Atomic Energy of Canada, Ltd[9]	Rolphton, Ontario	20	80	1961	Natural UO_2	Heavy water	Heavy water	485 530	1800	400	Saturated	300	AECL	CGE	.....	.....	.....

For footnotes see preceding page



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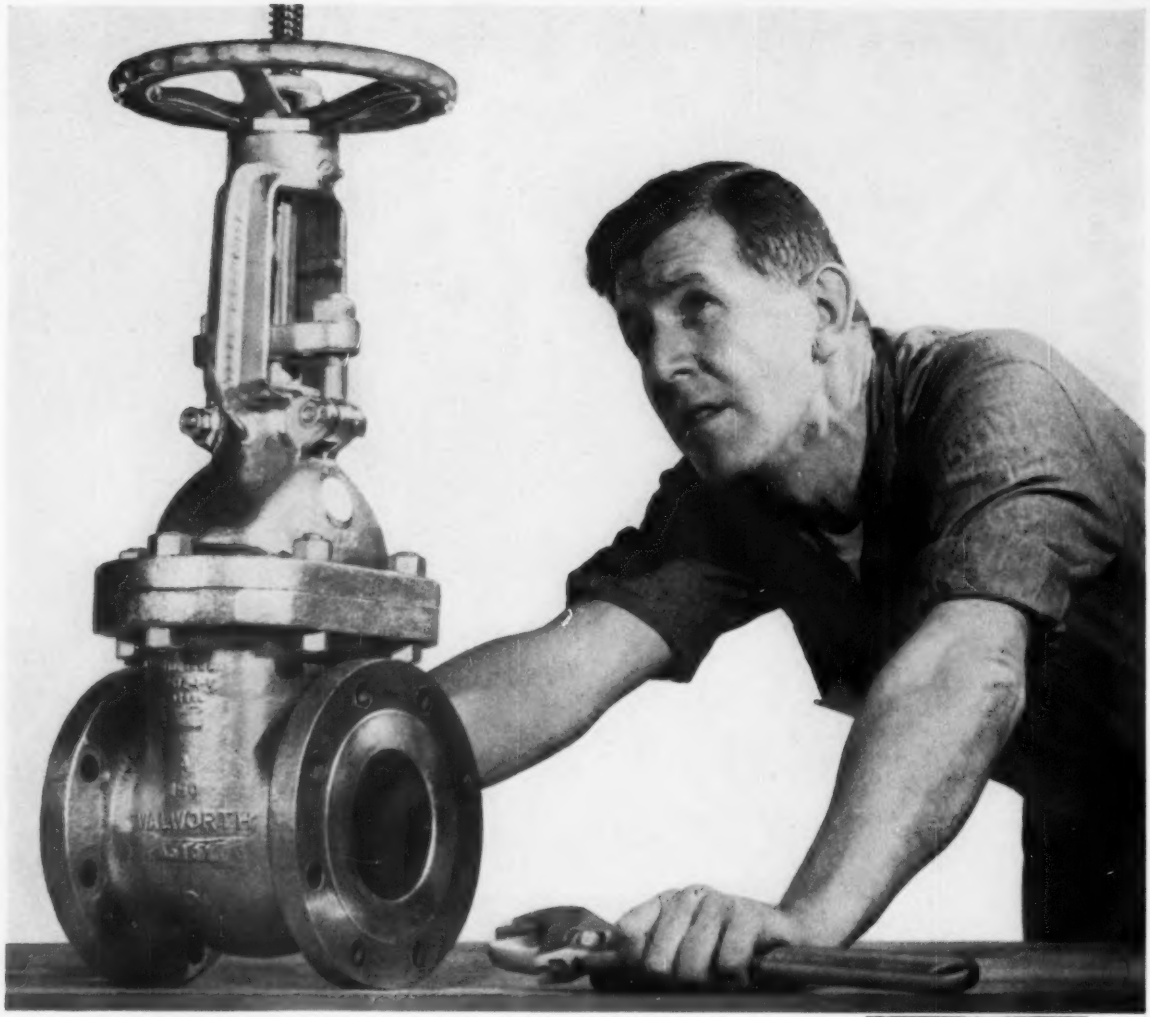

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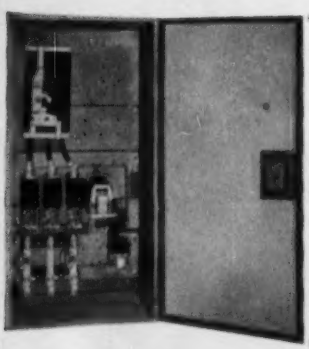

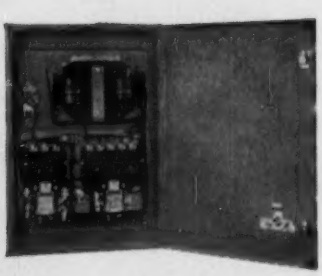

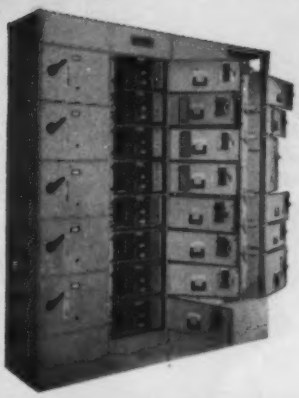

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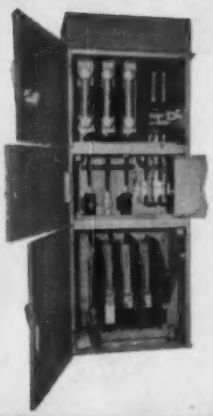

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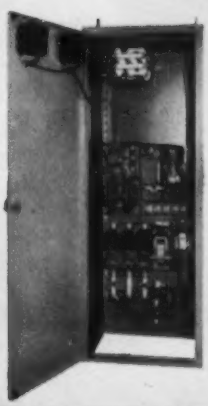

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The Story of Edward Research

and the "Perfect" Globe Valve

Edward designers built the Figure 848 forged steel globe valve from scratch. In an art where most development effort must be directed toward modification, adaptation, and refinement of existing technology, the 848 story is almost unique. The objective was simple: To design and construct a perfect 600-lb-class globe valve in the ¼" to 1" size range. (Basic rating 600 lb at 910 F, 2000 lb WOG.) That the project was virtually successful is a tribute to the ingenuity of the Edward Research Staff and the equipment which enabled them to validate their progress. Here, is that story.

Three areas were given special consideration by the Edward staff of engineers and metallurgists when they set out to design a "perfect" valve. They were: 1. Body Shell and Bonnet Joint; 2. Seat Tightness; 3. Packing Area. Although each area was treated separately, the relationship of one to the other was a factor that had a great deal to do with the outcome of the project.

A series of "torture" tests such as the pressure pulsator shown on the opposite page carried each part and joint to the point of destruction. Thus Edward designers were able to trace each weakness to its source. Perhaps no other valve ever designed has been known and understood so well by the men who designed it.

1. BODY SHELL AND BONNET JOINT. The valve bonnet was bolted finger tight; it tested at 2000 psi. Then, at full design tightness on all four bolts, the bonnet joint did not leak until 11,000 psi (5½ times design pressure!) was applied. Next, 8000 psi applied 100 consecutive times produced no apparent valve damage. Internal pressure was pulsated from 200 to 2000 psi for 10,000,000 cycles with no apparent damage!

The bonnet cap screws were subjected to 350% of design tightness before failure occurred. Further evidence of design effectiveness was the unpredictability of failure. In one case the threads stripped; in another the bolts broke off, and in other there was excessive bending of the bonnet flange. There was no *one* apparent point of weakness!

2. SEAT TIGHTNESS. Similar destructive tests were conducted on the valve stem and seat. The valve required on 65% of standard test closing torque to seal tight at 2000 psi. And 350% of standard torque was built up before the stem sheared below the handwheel. 100 operations at 2½ times standard torque did only negligible damage to seating surfaces. Even after this test only 90% of standard test torque was needed to hold 2000 psi.

3. PACKING AREA. Six times as much load as actually required to seal the packing chamber was applied to the gland bolts without causing damage. A load 3½ times greater than required for sealing was applied 50 times, also without causing damage.

Thus the "perfect" globe valve was designed; perfect not because it can't fail, but perfect because it has no apparent weaknesses. The full design and construction story is told in Edward Catalog 14-G.

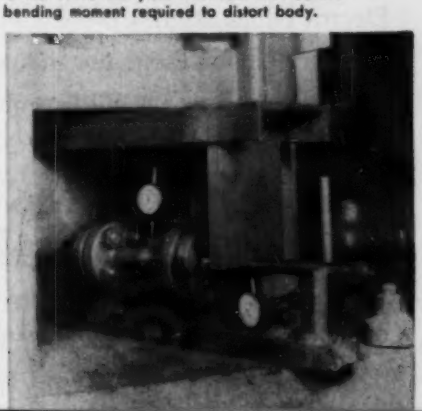
Edward builds a complete line of forged and cast steel valves from ¼" to 24" for industrial, marine, petroleum and technological services. For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal.

EDWARD STEEL VALVES
another fine product by
ROCKWELL

Chief Engineer C.A. Siver and Design Engineer Don Easton observe effects of pulsating pressure on newly designed Figure 848 forged steel globe valve in Rockwell-Edward Research Lab.

Rugged forged steel body . . . combined with high-strength stainless steel gland bolts and bonnet bolts, aluminum-bronze alloy yoke bushing, asbestos-stainless spiral gasket and other premium features . . . makes the Figure 848 a virtually "perfect" small steel valve.

Test arrangement produces uniform bending moment on valve and ½" pipe. Test shows that the strongest pipe likely to be attached to the valve will yield with less than ½ the bending moment required to distort body.



more than

93%

of United Electric's production
is taken by basic industries
and electric public utilities

COAL POWER for INDUSTRY

Electric public utilities, cement and chemical plants, meat packers, brewers and paper and steel mills are among the major industries in the Middle West which depend regularly each year on United Electric for millions of tons of coal shipped by rail, truck, river barge and lake vessel.

THE UNITED ELECTRIC COAL COMPANIES

COALS: FIDELITY • CUBA • BUCKHEART • RUBY • MARY MOORE • BANNER

CHICAGO, 307 N. Michigan Ave., Phone CEntral 6-6580 • PEORIA, Commercial National Bank Building, Phone 3-3711 • ST. LOUIS, Ambassador Building, Phone GArfield 1-3732

◀ Circle 844 on Reader Service card for preceding ad

For more facts circle 845 on Reader Service card, p 207

CP-989-R90 REVERSIBLE TUBE ROLLER. *115V AC or DC. Capacity: to 4" tubes. No load speed: 90 RPM. Spindle 1" square. Spindle offset 1⅝"*

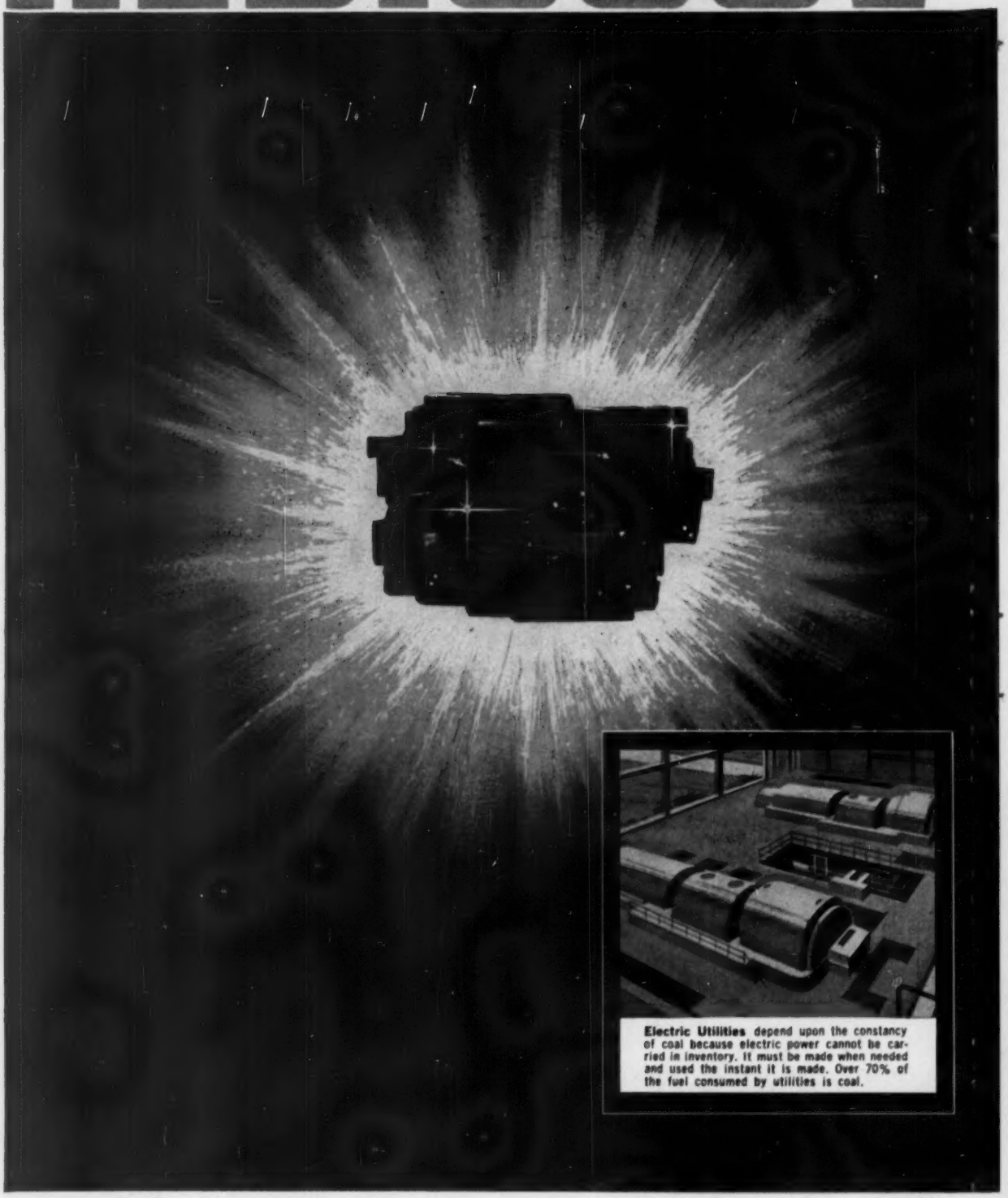
here's BRUTE POWER in close quarters FOR TUBE ROLLING

When a boiler maker, or boiler repairman, relies on a CP Reversible Electric Tube Roller, he gets brute power and plenty of it. On the CP-989, the quiet, helical gearing gives him low speed with extremely high torque. And he can load the CP right up to the stall point – repeatedly. Experts find the CP Electric Tube Roller just as dependable as it is indispensable . . . and in maintenance of boilers and heat transfer equipment, electric tube rolling equipment has the advantage of utilizing power that is always accessible.

Chicago Pneumatic *8 East 44th Street, New York 17, N. Y.*

PNEUMATIC TOOLS • ELECTRIC TOOLS • AIR COMPRESSORS • DIESEL ENGINES • HYDRAULIC TOOLS • AVIATION ACCESSORIES

REDISCOV



Electric Utilities depend upon the constancy of coal because electric power cannot be carried in inventory. It must be made when needed and used the instant it is made. Over 70% of the fuel consumed by utilities is coal.

ER COAL!

COAL IS ENERGY... producing low-cost kilowatt-hours for rnodern electrical living

As more and more Americans turn yesterday's household luxuries into today's necessities, electricity continues to be the greatest single force lifting our standard of living. In the last ten years our population has increased 20%. But the residential demand for electrical power during that time has risen 251%! For commercial and industrial use there has been a 150% increase. To satisfy this growing and boundless demand for dynamic energy, the electric utility industry has just about doubled its capacity every decade, all the while improving its fine record of giving more and more power for the consumer dollar.

Power companies are the biggest single user of coal. Nearly 70% of fuel-produced electric energy is generated by coal. Our country's five most efficient power plants, based on the 1958 report of the Federal Power Commission, operate 100% on coal.

In this booming energy market—and in other industries including steel making, process steam and heating as well — coal is the favored fuel. It offers the highest efficiency at lowest cost. It can match the stride of future consumption... is dependably, economically transported as needed by Chesapeake and Ohio's giant coal car fleet — and its abundant reserves can be counted upon for centuries.

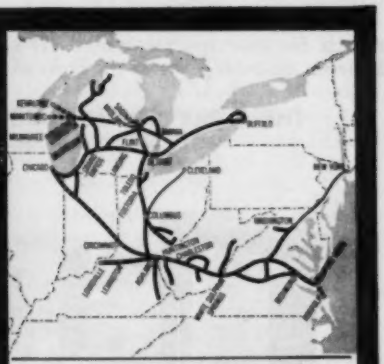
Chesapeake and Ohio Railway

TERMINAL TOWER, CLEVELAND 1, OHIO

Outstandability in Transportation

Coal is clean as well as economical for modern institutional heating. Advancements in handling and combustion equipment, electrostatic precipitators and other devices to prevent air pollution make coal the ideal fuel.

C&O Fuel Service Engineers offer free consultation in C&O's market areas on any problem of combustion, application, equipment or plant arrangement. Write to: R. C. Riedinger, General Coal Traffic Manager, at the address above.



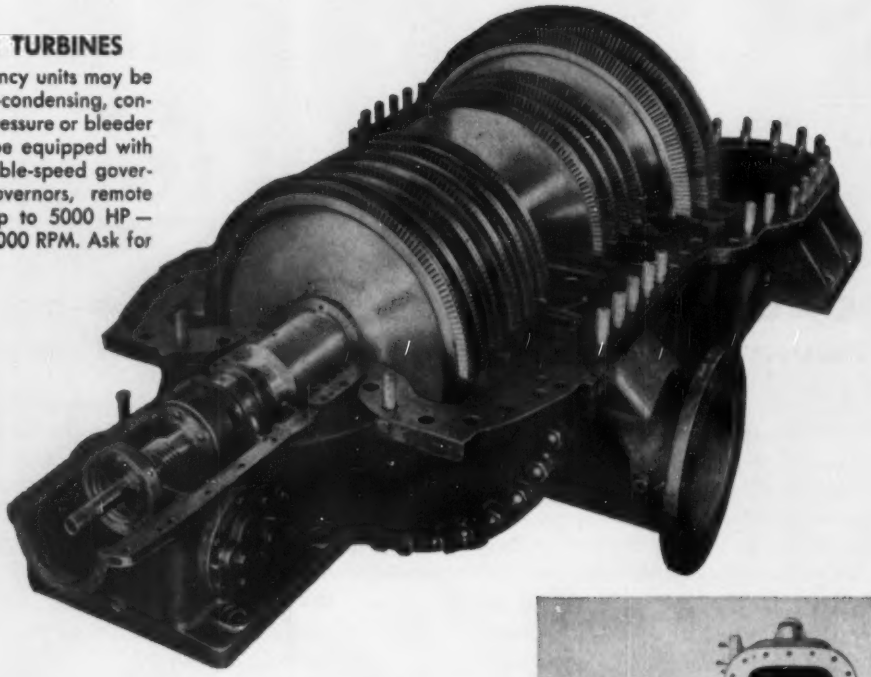
The 5100-mile Chessie Route directly serves over 300 mines in America's richest bituminous coal reservoir with the finest fleet of 68,000 coal cars. Specify C&O routing for dependable, efficient delivery.

CHESSIE SERVES THE COAL BIN OF THE WORLD

For more facts circle 847 on Reader Service card, p 207

MULTI-STAGE TURBINES

These high-efficiency units may be designed for non-condensing, condensing, mixed pressure or bleeder operation. Can be equipped with constant or variable-speed governors, special governors, remote controls. Sizes up to 5000 HP — Speeds up to 10,000 RPM. Ask for Bulletin S-146.



There's a **Terry turbine** for every mechanical-drive requirement

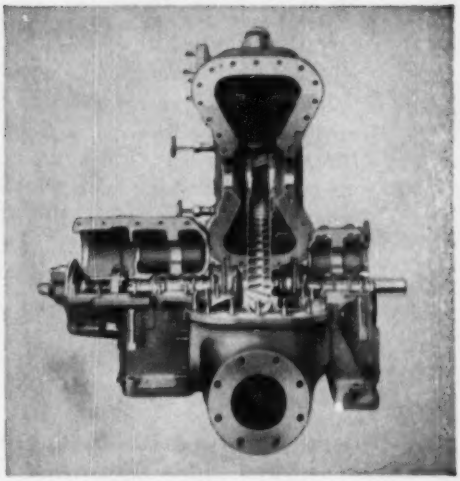
The designs for Terry turbines are based on more than 50 years of successful experience in the manufacture of turbine drives *exclusively*. This specialization has resulted in Terry becoming one of *the leading producers* of mechanical-drive turbines in sizes up to 5,000 horsepower.

There are three basic reasons why Terry has been able to maintain this position of leadership: (1) a thorough knowledge of the requirements of mechanical-drive turbines, (2) a willingness to build "a little something extra" into each machine to assure trouble-free operation, and (3) an acknowledgement of the company's responsibility to stand behind the performance of every turbine sold.

These are also the reasons why you should consider a Terry turbine for your next mechanical drive. In the meantime, send for bulletins describing any of the types of machines illustrated.

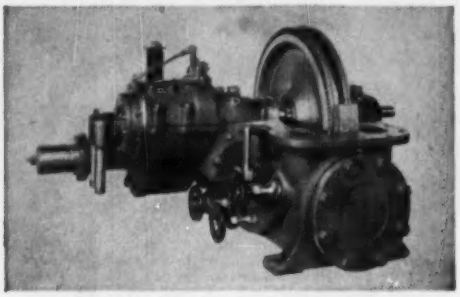
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



SOLID-WHEEL TURBINES

Famous for sure dependability and ease of inspection. Can be started cold — no preliminary warming required. Available in vertical designs depending on frame size. Capacities from 5 to 2,000 HP. Described in Bulletin S-116.

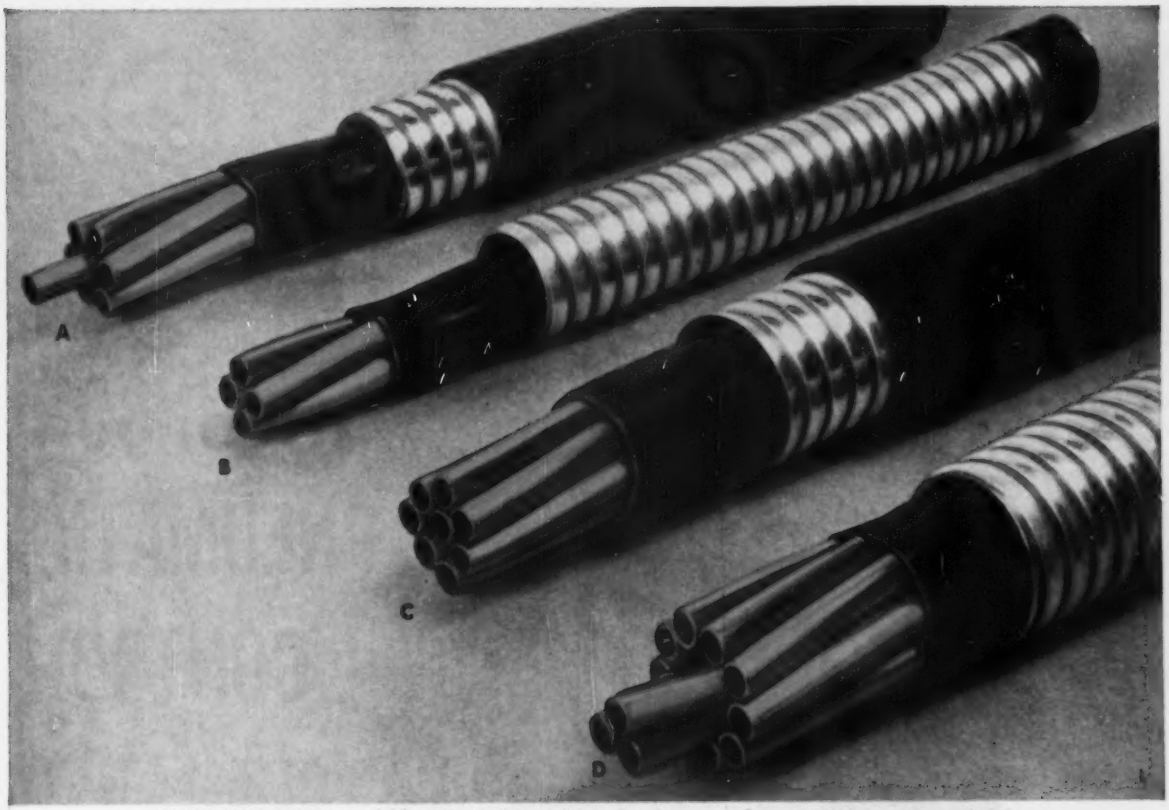


AXIAL-FLOW IMPULSE TURBINES

Built with one, two or three rows of high-grade stainless steel blading, these turbines combine efficiency with durability. Available in designs for moderate and high steam pressure. Bulletin S-143.

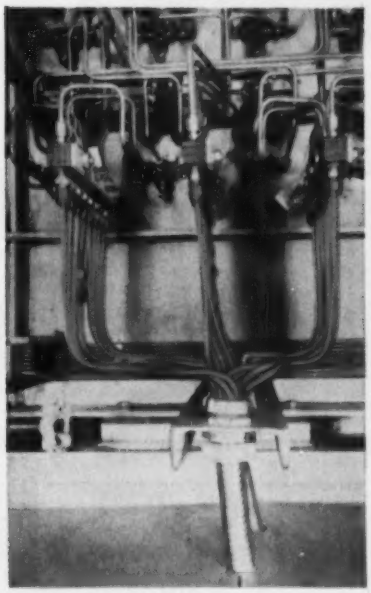
TT-1209

For more facts circle 848 on Reader Service card, p 207



BAILEY ARMORTUBE is available with *A*, thermoplastic sheath over steel armor; *B*, thermoplastic sheath under steel armor; *C*, thermoplastic sheath over and under steel armor; or *D*, with just steel armor.

For its "Armortube" control system cables, Bailey specifies Anaconda precision copper tube in long coils



A TYPICAL INSTALLATION of Bailey Armortube in a large utility, indicating the large number of separate lines carried by two easily installed cables.

Armortube® flexible, armored, multiple-tube cable made by Bailey Meter Company, Cleveland, Ohio, has saved up to 40% of single-tube installation and maintenance costs in pneumatic, metering and control systems.

Armortube cable is available in lengths up to 1000 feet and in bundles of up to 19 individual ¼" O.D. copper tubes. Steel interlocking armor protects the tubes from mechanical damage and simplifies installation. In addition, various combinations of thermoplastic sheathing are available to provide further protection from moisture and corrosive atmospheres during and after installation.

CLEAN AND DRY. The copper tubes must meet rigid quality specifications, and Bailey has found that Anaconda copper tube consistently meets its requirements. Anaconda takes special care to see that inside surfaces are clean, smooth, and bright—free from dust, dirt, or metal chips which might interfere with the operation of delicate air and hydraulic circuits. Tube ends are sealed to keep out moisture and foreign matter during storage.

FLEXIBLE AND ACCURATE. Anaconda copper tubes are uniformly soft, highly flexible—for easy bending during installation. And they are accurate in size and shape.

LONG LENGTHS. For applications such as instrumentation, Anaconda can produce copper tubing in coils up to 2200 feet for ¼" O.D.—up to 1400 feet for ⅜" O.D.—up to 1000 feet for ½" O.D.

QUALITY TUBE AND CREATIVE TECHNICAL SERVICES. Whatever your requirements for precision copper tubing—instrumentation or capillary tubing, or restrictor tubes – Anaconda specialists can help you find the most economical way to do the job. For such technical assistance, see your Anaconda representative, or write: Anaconda American Brass Company, Waterbury 20, Conn. 6068L

ANACONDA®

INSTRUMENTATION TUBING

Anaconda American Brass Company

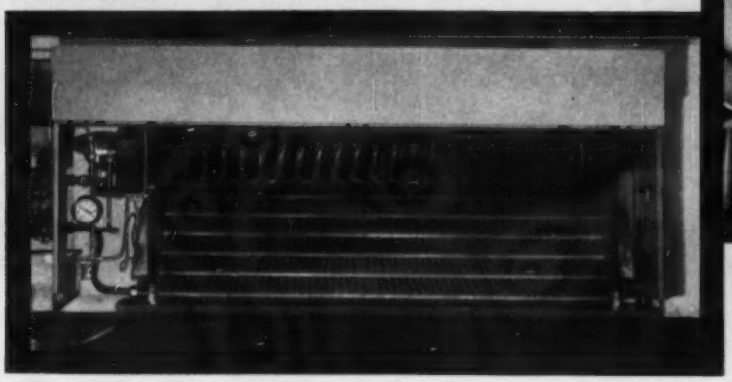
For more facts circle 849 on Reader Service card, p 207

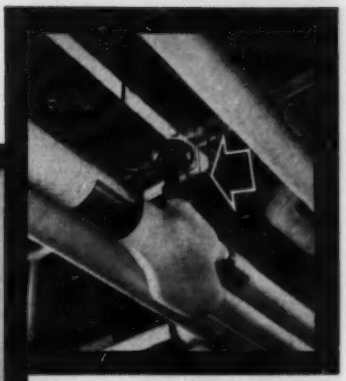
JOHNSON PNEUMATIC CONTROL

Kemper Insurance Building, Chicago. For the modernization program: Childs & Smith, architects and engineers, Chicago; Mehring & Hanson Co., mechanical contractors, Chicago.

Over 2,000 Johnson thermostats maintain an ideal climate for business. Individual office controls eliminate a major cause of complaints, contribute to tenant satisfaction.

Johnson thermostats and water valves control over 3,100 induction units. These popular valves have an unmatched record of trouble-free service in such installations. The air gauge simplifies thermostat calibration, allows thermostat and valve operation to be checked at a glance.





Johnson 3-way mixing valves and by-pass valves can be serviced without removal, an exclusive Johnson feature that cuts service time over 50%. They also permit simple straightaway piping hookups for faster installation.

...assures ideal comfort, lowest lifetime costs

FAMOUS CHICAGO SKYSCRAPER SHOWS HOW IT'S DONE

As one of Chicago's top-rated buildings, the Kemper Insurance Building (formerly the Civic Opera Building) demanded air conditioning controls that would meet the very highest comfort standards. For economy, thrifty planners wisely also insisted on reliable, trouble-free controls.

A specially planned Johnson Pneumatic Control System meets both of these requirements. It provides coordinated operation of air conditioning systems supplying conditioned air at the rate of 600,000 cfm. The complex installation includes 8 large central fan air conditioning systems, 5 secondary water systems, and more than 3,100 underwindow induction units, all of which are Johnson-controlled. Offices throughout the 42-story modernized structure are individually regulated to maintain a comfortable, productive working climate for some 5,700 people.

Being pneumatically operated, the Johnson System functions dependably and with a minimum of supervision and upkeep. Both the system and its components incorporate economy features that result in important long-range savings.

Johnson Pneumatic Systems are designed and installed to provide you with the finest in modern comfort control at the lowest possible lifetime cost. When you build or air condition, ask your consulting engineer, architect, or local Johnson representative to explain how these advantages can be applied to your building. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

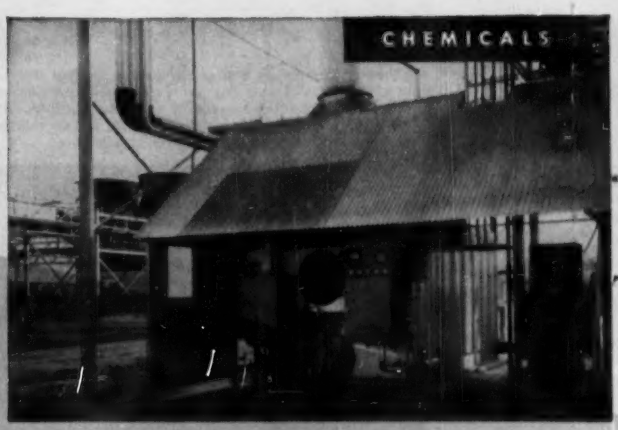
JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

For more facts circle 850 on Reader Service card, p 207

3 — 60,000 lbs./hr. Erie City Natural Circulation Keystone Package Steam Generators — oil fired — outdoors — a large eastern steel mill.



1 — 30,000 lbs./hr. Erie City Natural Circulation Keystone Package Steam Generator — gas and oil fired — outdoors — Southern Nitrogen Co., Savannah, Ga.

You'll Find KEYSTONE

Wherever Engineers Insist on the Very Best

Indoors or outdoors, at home or abroad, wherever you look you will find Erie City Keystones delivering low cost, economical steam. The Keystone combines the best in design features and sound construction procedures to deliver a package water tube steam generator with unsurpassed advantages. These mean savings to you.

Symmetrical Design — easy to unload, easy to move.

Tangent Furnace Tubes — act as baffle, no heavy refractory tile required.

Tangent Outer Tubes — plus steel jacketed insulation keep heat loss to a minimum.

Welded Inner Seal Casing — eliminates casing corrosion problems.

If you are presently in the market for a water tube package generator or if future expansion may require a unit of this type, investigate the Keystone. You owe it to yourself to see one in operation before you buy. For detailed catalog information, write for Bulletin SB-6301-K.

KEYSTONES Known by Companies They Serve

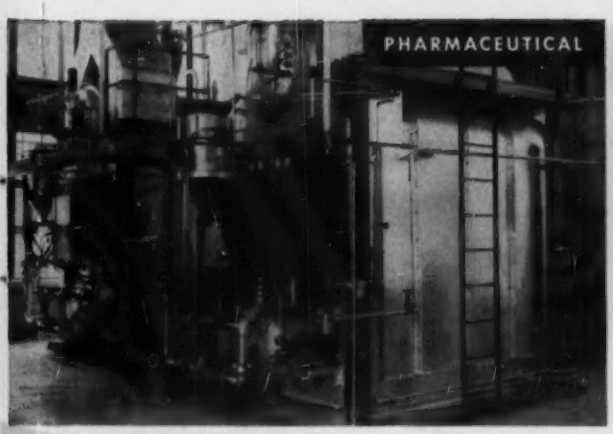
• HERE ARE A FEW:

Amalgamated Sugar Co.
American Cyanamid Co.
Bay Petroleum Corp.
Clark Equipment Co.
Firestone Tire and Rubber Co.
Foote-Burt Co.
Kraft Foods
Gulf Oil Corp.
McDonnell Aircraft Corp.
Miles Laboratories, Inc.
Oregon Pulp and Paper Co.
Pittsburgh Plate Glass Co.
Reynolds Metals Corp.
Sherwin-Williams Co.
Texas Co.
Welch Grape Juice Co.

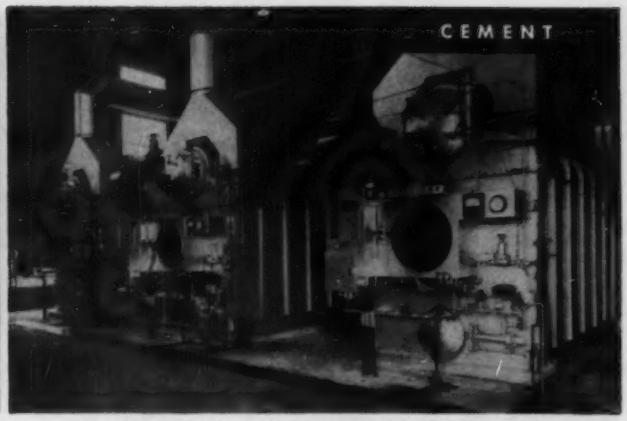
You can depend on ERIE CITY *Since 1840 for sound engineering*

ERIE CITY IRON WORKS • Erie, Pa.

STEAM GENERATORS • • • SUPERHEATERS • • • STOKERS • • • PULVERIZERS
ECONOMIZERS • • • WASTE HEAT BOILERS • • • OIL and GAS BURNERS
AIR PREHEATERS • • • FIRE and WATER TUBE PACKAGE BOILERS

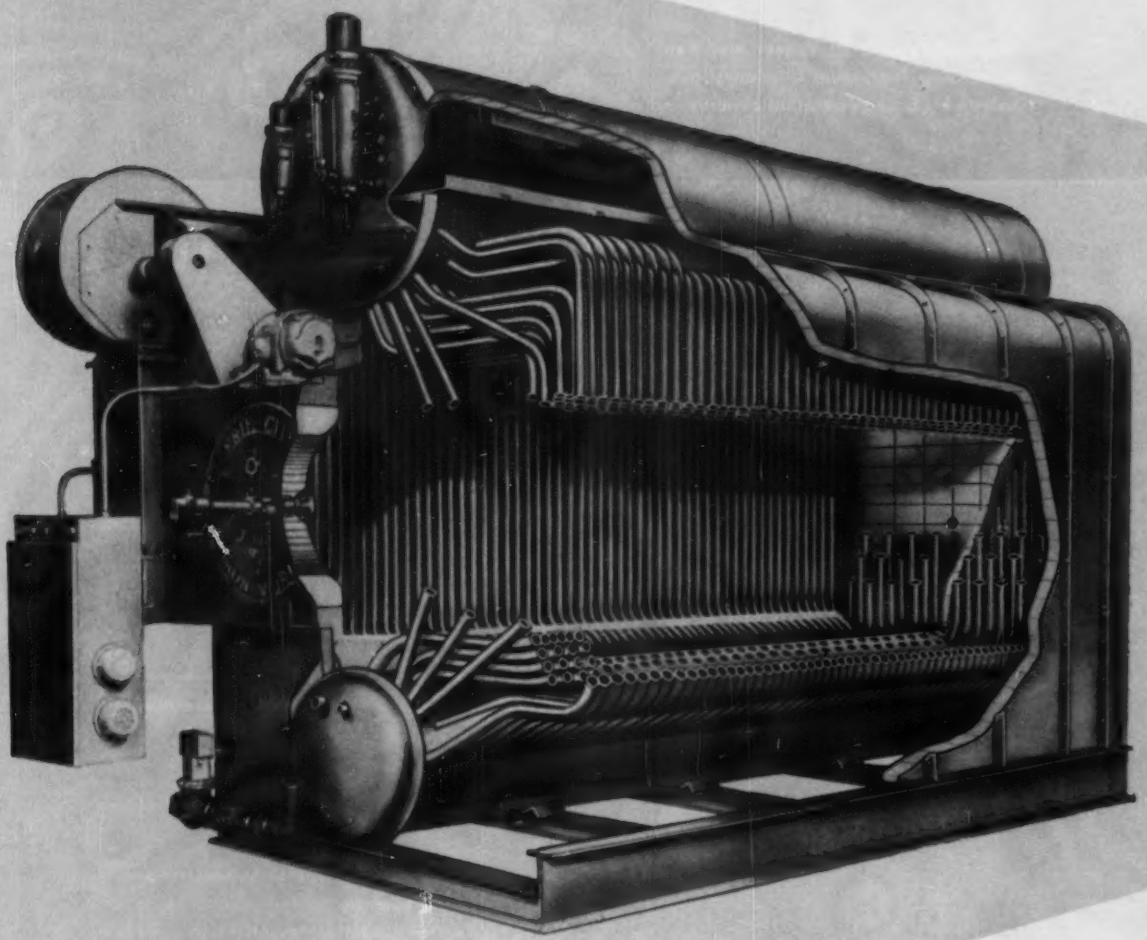


2 — 8500 lbs./hr. Erie City Natural Circulation Keystone Steam Generators — gas and oil fired — Eli Lilly & Co., Greenfield, Ind.

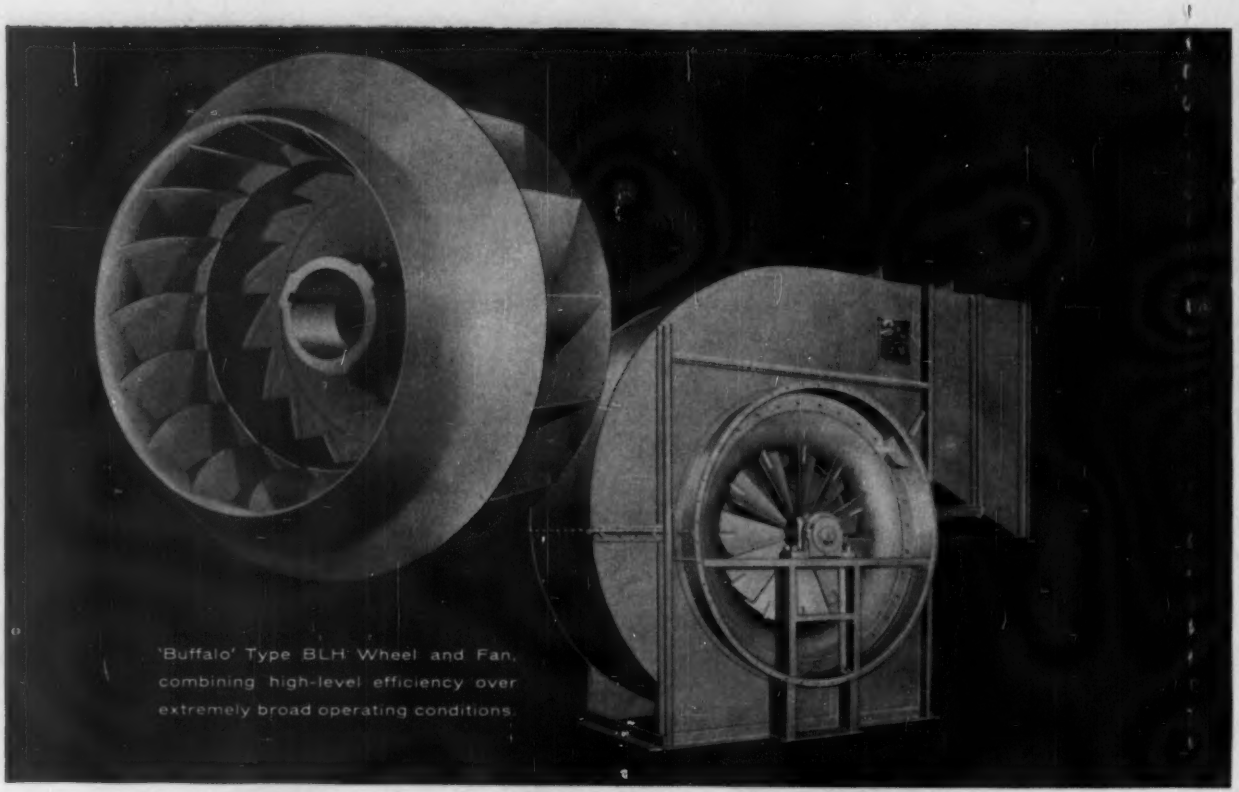


3 — 20,000 lbs./hr. Erie City Natural Circulation Keystone Steam Generators — oil fired — Fabrica Dominicana De Cemento, Ciudad Trujillo, Dominican Republic.

Steam Generators

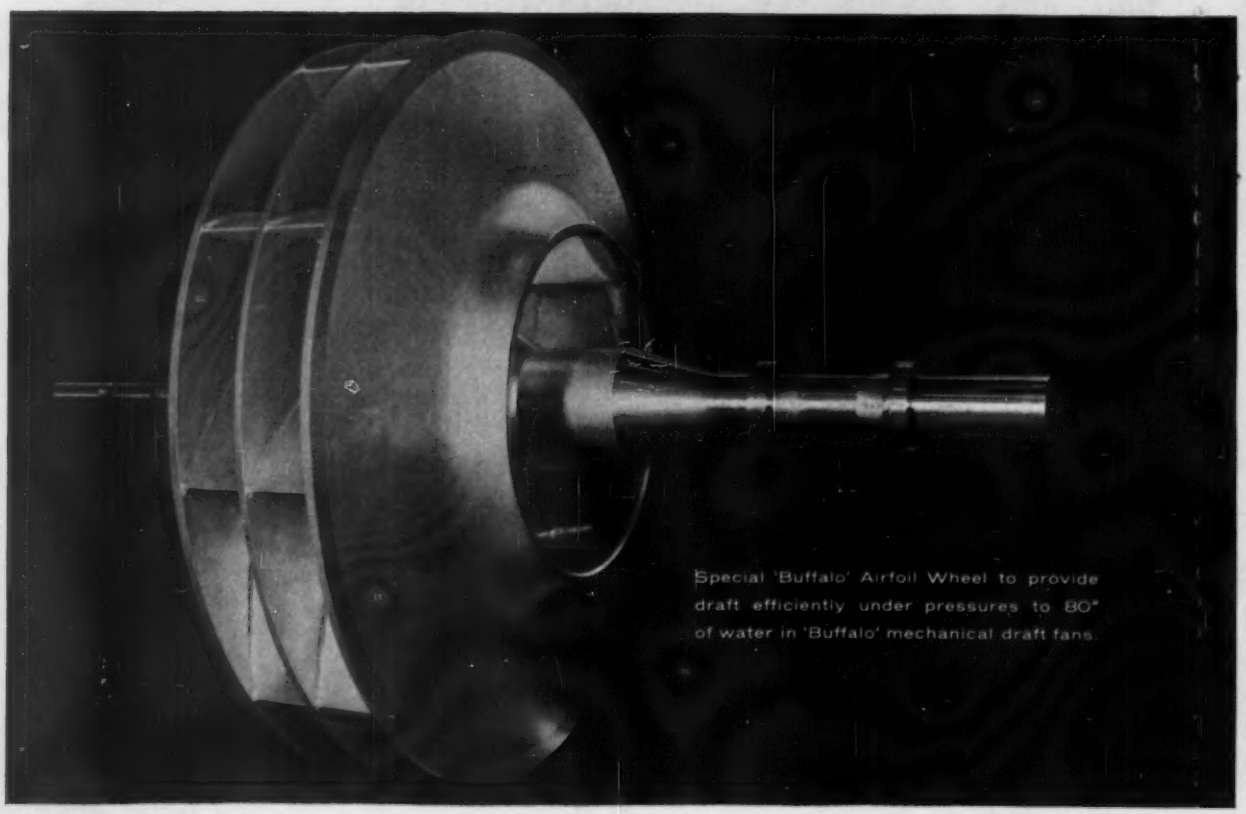


For more facts circle 851 on Reader Service card, p 207



'Buffalo' Type BLH Wheel and Fan, combining high-level efficiency over extremely broad operating conditions.

WHAT ARE



Special 'Buffalo' Airfoil Wheel to provide draft efficiently under pressures to 80" of water in 'Buffalo' mechanical draft fans.

FOR FLEXIBLE OPERATION WITH NO SACRIFICE IN EFFICIENCY

Where you plan to operate at varying pressures and volumes—yet still desire high-level efficiency—'Buffalo' Type BLH Fans are the logical choice. Their performance curve covers a broad range at well over 80% efficiency. This means significant power savings under wide-open or dampered operation plus stable performance from free delivery to shutoff.

Such performance would not be possible without exclusive 'Buffalo' engineering features. The 'Buffalo' Wheel, shown at left, has deep, backward curved blades for smooth, quiet handling of air. Its inlet flange is dished to form a perfect semi-circular entry path with the matching bell-shaped housing inlet. There are no flat spots to cause turbulence. Fixed or variable 'Buffalo' inlet vanes may be used without reducing efficiency.

The 'Buffalo' housing is streamlined and suited to this particular wheel for smoothest air passage. Its exclusive 'Buffalo' divergent outlet delivers air into the duct with easy, gradual enlargement for best distribution and static conversion.

For flexible operation at money-saving efficiency, it will pay you to write for Bulletin FD-905 and investigate 'Buffalo' BLH Fans.

YOUR DRAFT REQUIREMENTS?

FOR EFFICIENCY AT EXTREME PRESSURES

Everything about this fan was designed for lowest-cost draft under the highest pressures.

The wheel, left, is the exclusive 'Buffalo' deep-blade airfoil design, known for its extreme efficiency. As with the BLH, described above, the inlet wheel flange matches the semi-circular housing inlet bell and its streamlined housing scroll has the exclusive 'Buffalo' divergent outlet — all providing the smoothest air flow possible with the highest static efficiency.

The fan housing and inlet box are of all welded construction, split for easy removal of shaft and rotor where specified. Highly stressed areas are fabricated of hammered forgings where required. Sleeve type bearings are supplied with circulating oil systems, water cooling or air cooling as required. These fans, by design and manufacture, are adequate in every respect for your highest pressure draft performance at the lowest overall cost.

Whatever your mechanical draft requirement, there is an up-to-the-minute 'Buffalo' Fan tailor-made for the job. Call in your 'Buffalo' Engineering Representative for recommendations and complete details.

"Buffalo"

AIR HANDLING DIVISION

BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

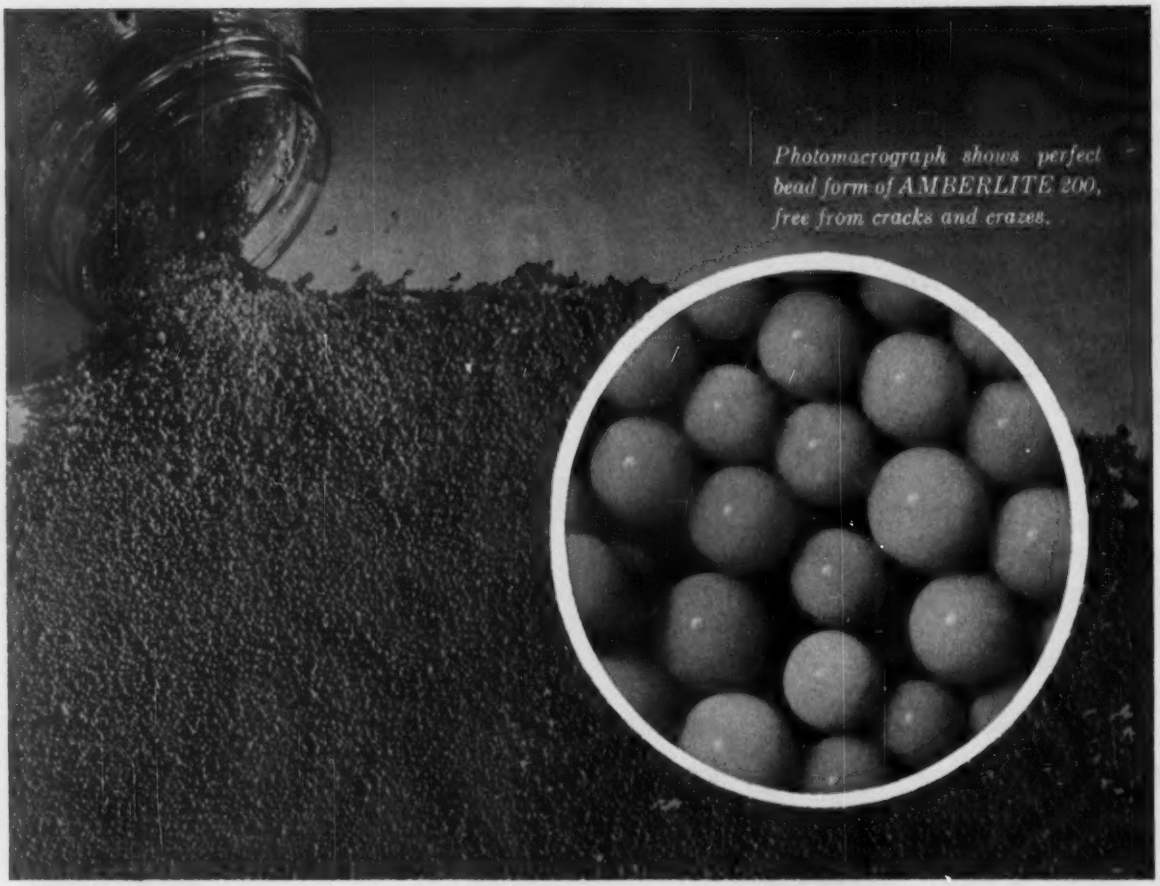
'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

For more facts circle 852 on Reader Service card, p 207



AMBERLITE 200

Introducing new durability for Ion Exchange Resins

AMBERLITE 200 represents an entirely new concept in polymer chemistry. A high capacity, strongly acidic cation exchange resin, AMBERLITE 200 has physical and chemical stability unmatched by any available cation exchange resin.

These are some of the outstanding features of AMBERLITE 200 . . . *high resistance to oxidation,* especially in water containing chlorine, oxygen and metals such as iron, copper and manganese; *perfect bead form,* free of cracks and crazes; *high attrition resistance; stability over the entire pH range; insolubility in all common solvents.*

In water treatment in either hydrogen or sodium cycle operation, the exceptional bead characteristics of AMBERLITE 200 make possible more rapid and complete bed classification, low losses from mechanical attrition, and greater freedom from bead fracture caused by thermal and osmotic shock. For example, 2000 regeneration-exhaustion cycles using saturated brine and calcium chloride showed no measurable resin breakdown, whereas conventional cation exchange resins showed failure of from 20 to 75 percent.

Write for full information and samples on this radically new AMBERLITE resin.

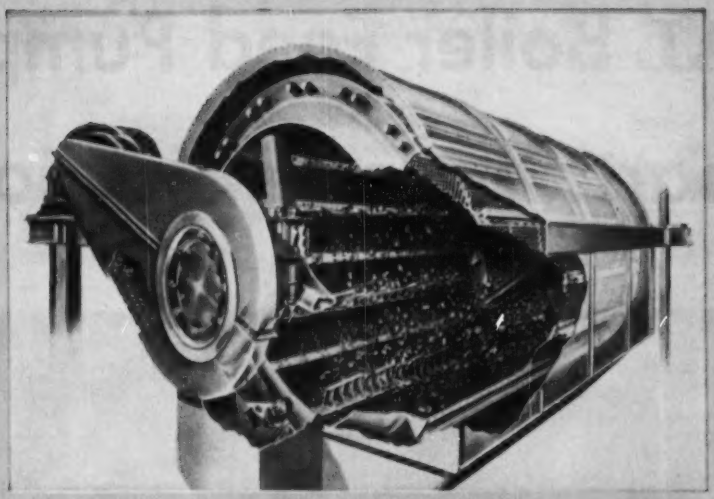
AMBERLITE *is a trademark, Reg. U.S. Pat. Off. and in principal foreign countries.*

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

For more facts circle 853 on Reader Service card, p 207



Pennsylvania Bradford crushes, sizes, scavenges all in one operation—at lowest cost

PENNSYLVANIA BRADFORD BREAKERS prepare over 160 million tons of coal each year

Because no other coal processing machine does so much for so little—Pennsylvania Bradford Breakers have become a standard of the industry.

At power plants, by-product coke plants, coal mines and coal cleaning plants Pennsylvania Bradfords clean, size and scavenge at phenomenal low cost.

Data from 10 installations over 8 years shows an average maintenance cost of $.001 per ton, and an average power consumption of .204 KW per ton.

TRIPLE ACTION

Continuously charged, the Pennsylvania Bradford immediately screens out passing sizes of coal through the screen plates. Larger lumps are raised and dropped, breaking by gravity impact until they are screened. All refuse—sulphur balls, slate, rock, tramp iron, etc.—resist breakage and travel the full length of the breaker where they are discharged.

BRADFORD-HAMMERMILLS

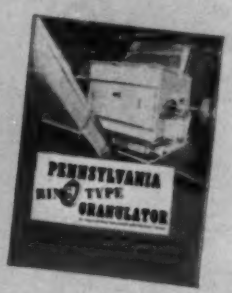
For reduction of particularly hard coals and for heavier loading, Bradford-Hammermills are frequently specified. This machine combines a concentrically-mounted rotor of a hard-hitting Pennsylvania Hammermill at the rear end of the slow speed Bradford Breaker. Capacities are increased over 20%.

FREE BULLETIN

For the full story on Pennsylvania Bradford Breakers and Bradford-Hammermills write for Bulletin 3007.

RING-TYPE GRANULATORS

For preparing coals for stoker and pulverizer fuel, and other uses where overgrinding is undesirable, Pennsylvania Ring-type Granulators have no peer. Exclusive design; exclusive advantages. Completely described in Bulletin 9002. Send for it.



PENNSYLVANIA CRUSHER DIVISION
BATH IRON WORKS CORPORATION
WEST CHESTER, PENNA.

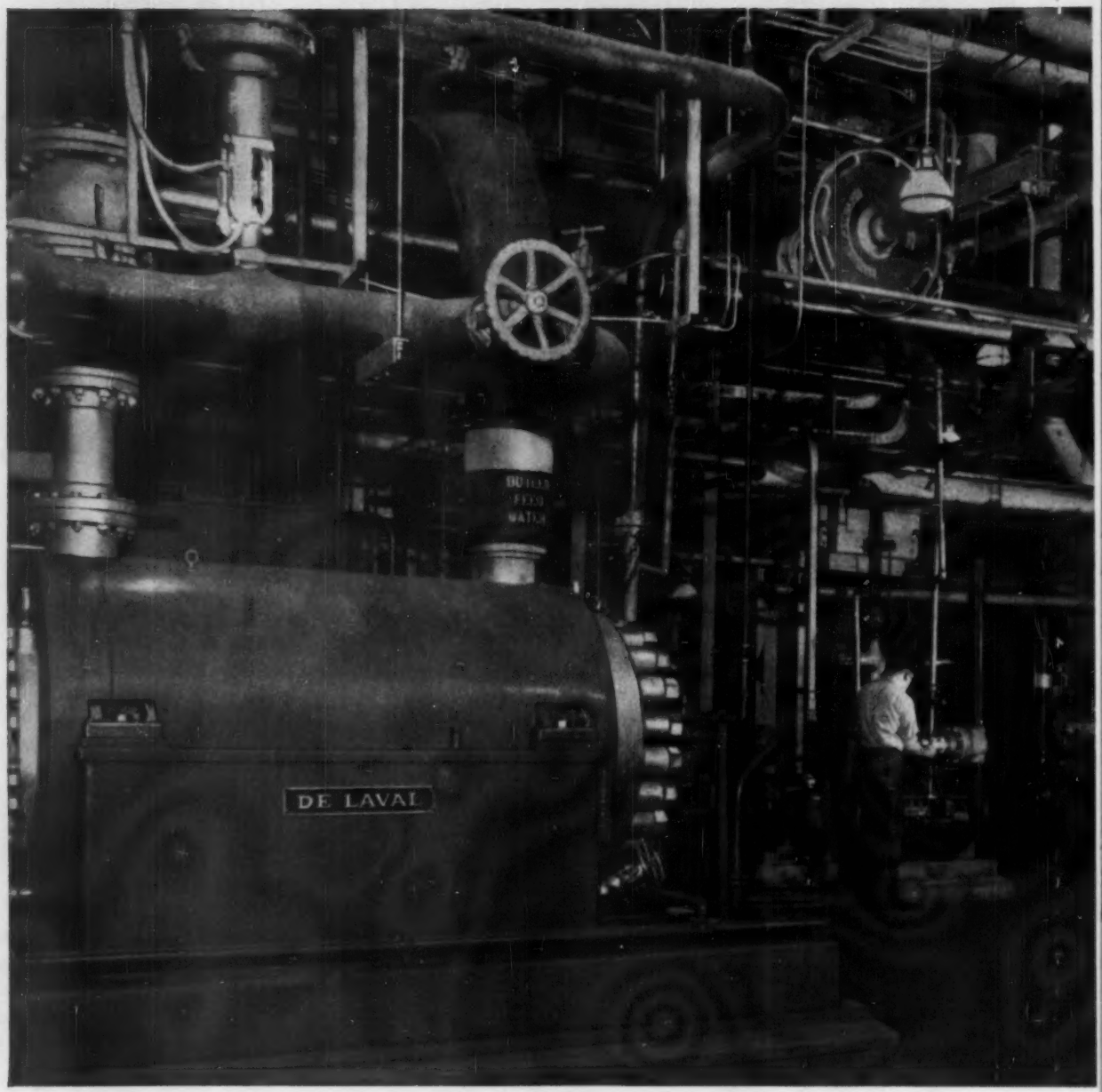
* * *

Over 50 years concentrated experience in all types of material reduction makes Pennsylvania your best source of crushers and engineering advice and service. Call on Pennsylvania with your next crushing problem. Representatives from coast-to-coast.

PENNSYLVANIA
BATH-BUILT
CRUSHERS

For more facts circle 854 on Reader Service card, p 207

DE LAVAL Boiler Feed Pumps part of modernization



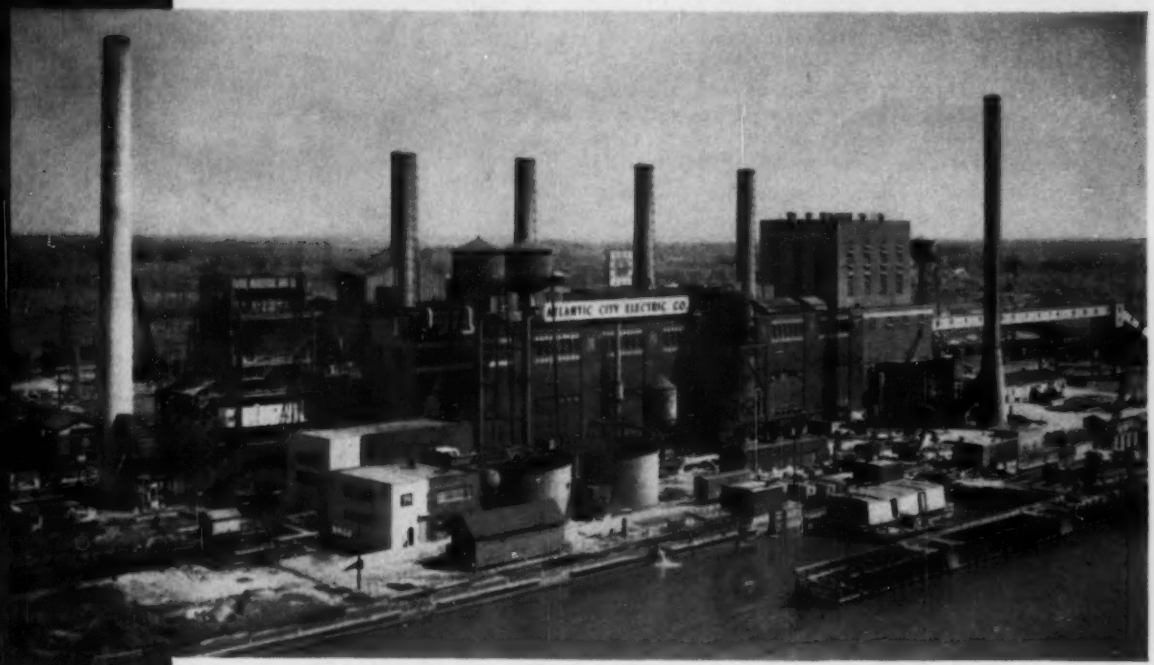
Each De Laval pump has intermediate pressure bleed off for use in controlling steam temperature from reheater.

at Atlantic City Electric

Gibbs & Hill, Inc., Consulting Engineers, handled project for new 79,000 KW unit

To meet increased load demand while improving station performance, Atlantic City Electric has completed the installation of a new 79,000 KW No. 1 main unit at Deepwater Station, the largest now operating in their system.

Providing dependable boiler feed service are two 1000 HP direct motor driven half capacity De Laval barrel feed pumps, now in their second year of operation. This is the second modern installation at Deepwater to be served by De Laval barrel pumps.



Deepwater Station at the southern extremity of the N. J. Turnpike.

DE LAVAL STEAM TURBINE COMPANY
815 NOTTINGHAM WAY, TRENTON 2, N. J.

DL 814

A "quick open" package for insulation products...

"K&M" TEAR-TAPE CARTON

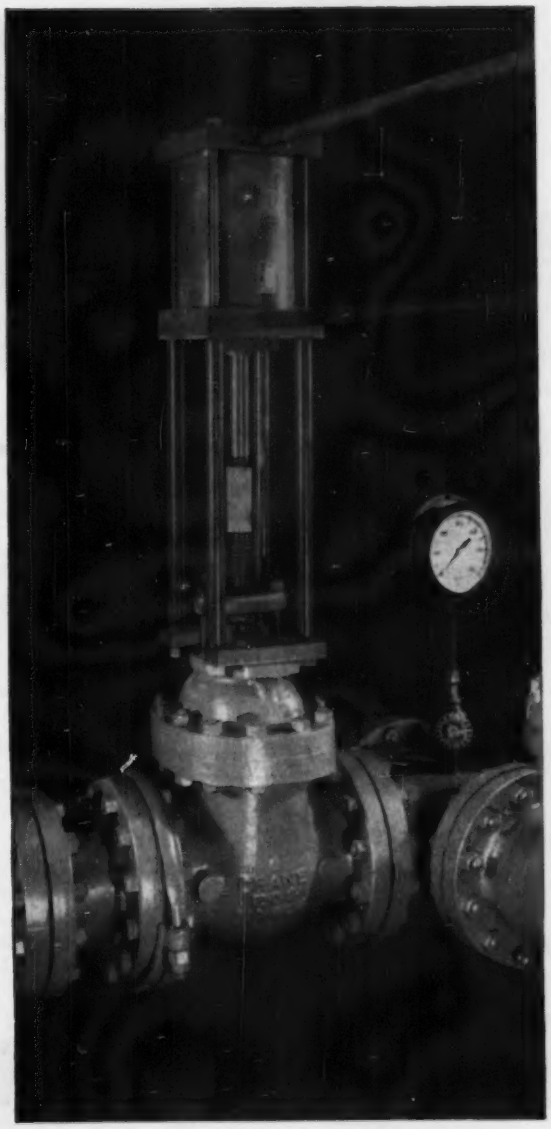
Opens neat and easy...like a coffee can lid!
Easy does it . . . with the new "K&M" "Tear-Tape" Carton. Just pull the tab on the front panel. The top of the carton comes off cleanly and easily. No strain! No stress! No time and energy wasted! Your "K&M" KaytherM Block Insulation is open and ready to use in seconds.
Keep an eye on K&M! This is only one of a stream of exciting ideas on new products and customer service pouring out of K&M! Write today for more information on the new "Tear-Tape" Carton to: Keasbey & Mattison Company, Ambler, Pa. Dept. I-1100.
• Pull tab.
• Strip of board peels off like band of tin around top of coffee can.
• Whole lid lifts off for easy access to "K&M" KaytherM Block Insulation.
K·M
Keasbey & Mattison at Ambler
BLOCK INSULATION
"KAYTHERM"

For more facts circle 856 on Reader Service card, p 207

CRANE
DIRECTION '70

... a fast-moving program of planned expansion, product development, and streamlined distribution to help our customers meet the competitive challenges of the Sixties.

NEW CRANE CYLINDER OPERATORS— LOW-COST POWER OPERATION FOR GATE VALVES



Now you can control any flow process easier and faster with cylinder operated Crane valves. Large valves . . . valves in remote or inaccessible locations . . . valves that must be cycled many times a day . . . all these can now be operated at the touch of a finger, saving time and manpower. These benefits of power operation are available from Crane now—at lower cost and in less time than ever before!

Crane cylinder operators are available for Crane O. S. & Y. iron body wedge and double-disc gate valves, and for pulp stock valves. Control devices for local or remote actuation supplied at extra cost.

And you can get these new operators for modernization of your present Crane gate valves, too. Easy-to-install adapter is shipped with every cylinder. Field installation can be done in 30 minutes or less, without removing the valve from the line.

This new valve operator is another example of how Crane solves your flow problems more economically, more productively. The Crane solution —the right answer to your flow problems—is as close as a phone call to your Crane distributor. Call him today.

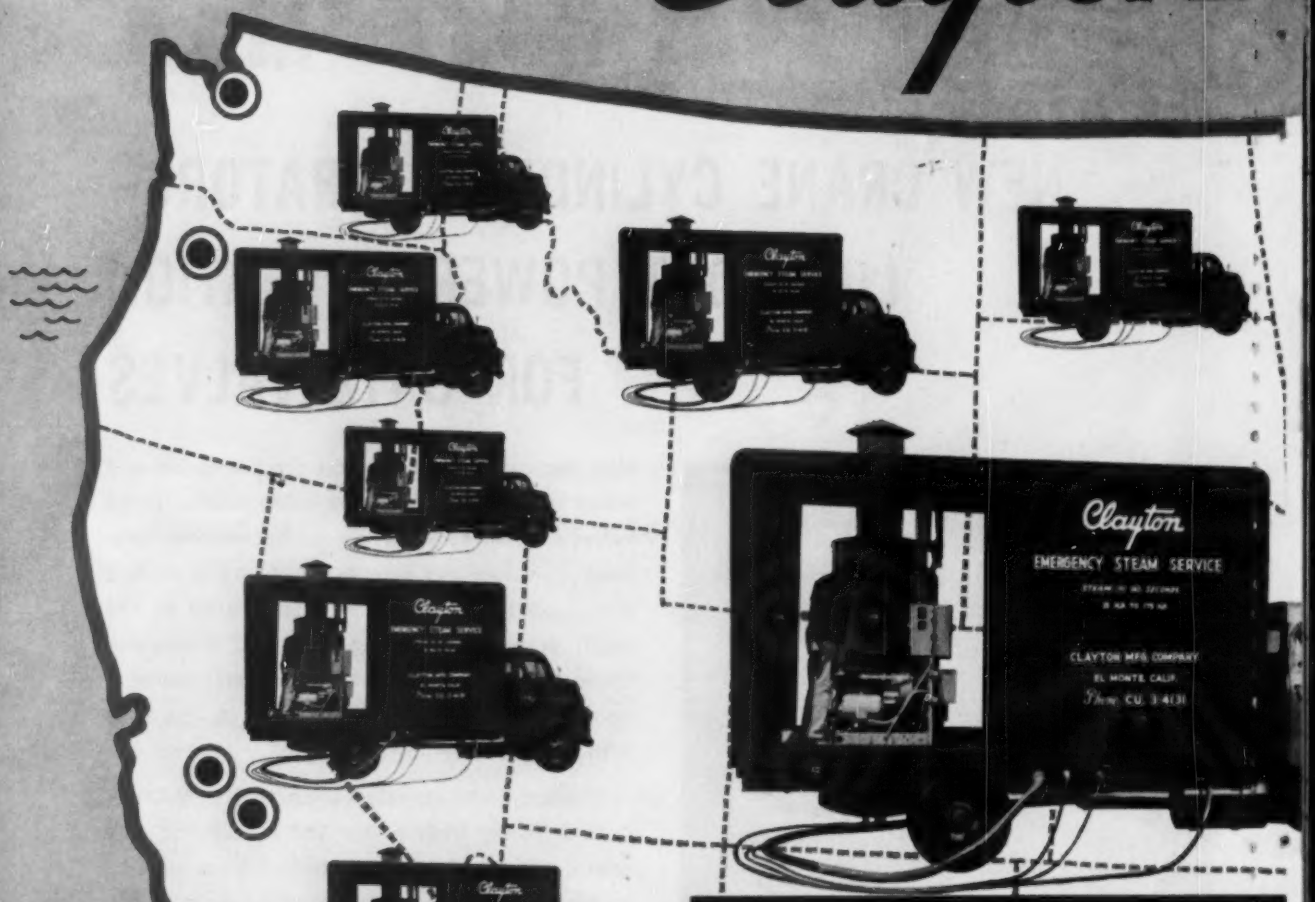
CRANE®

CRANE CO., INDUSTRIAL PRODUCTS GROUP
4100 S. Kedzie Avenue, Chicago 32, Illinois
Valves • Electronic Controls • Piping • Plumbing
Heating • Air Conditioning • Cyclotherm® Boilers • Heat
Exchangers • Marine Products • Powdered Metals

For more facts circle 857 on Reader Service card, p 207

Circle 858 on Reader Service card for following ad ➤

Clayton



AVOID DOWN-TIME LOSSES!

Clayton Distributors in key industrial areas provide fast steam to meet your emergency or standby needs.

- Mobile, truck-mounted Clayton Steam Generators are ready to roll at a moment's notice. Most units are 100 HP. Many are 175 HP. Pressure up to 300 psi.
- Tandem operation of several units provides emergency steam for greater horsepower requirements.
- Units are completely self-contained and ready for operation.
- The only time factor is the highway speed limit. The Clayton delivers full steam service in just 3 minutes after simply tying into your steam lines.
- For name and address of the Clayton Steam Generator Distributor nearest you, providing Emergency Steam Service, check your Yellow Pages or write Clayton. In an emergency, wire collect. Your nearest distributor will also bring this same mobile unit to your plant for an on-the-job demonstration without cost or obligation.

See Clayton Exhibit, National Power Show—N.Y.—Nov. 28-Dec. 2. Booth 171.

EMERGENCY STEAM SERVICE

Clayton MANUFACTURING COMPANY

465 North Temple City Blvd., El Monte, California

DON'T WAIT FOR AN EMERGENCY! Contact Clayton NOW!

Clayton Manufacturing Company 421

☐ Please send name and address of nearest Clayton Emergency Steam Service distributor, with full information.

☐ Also send information on Clayton Steam Generators.

☐ Have representative call.

Name _____

Company _____

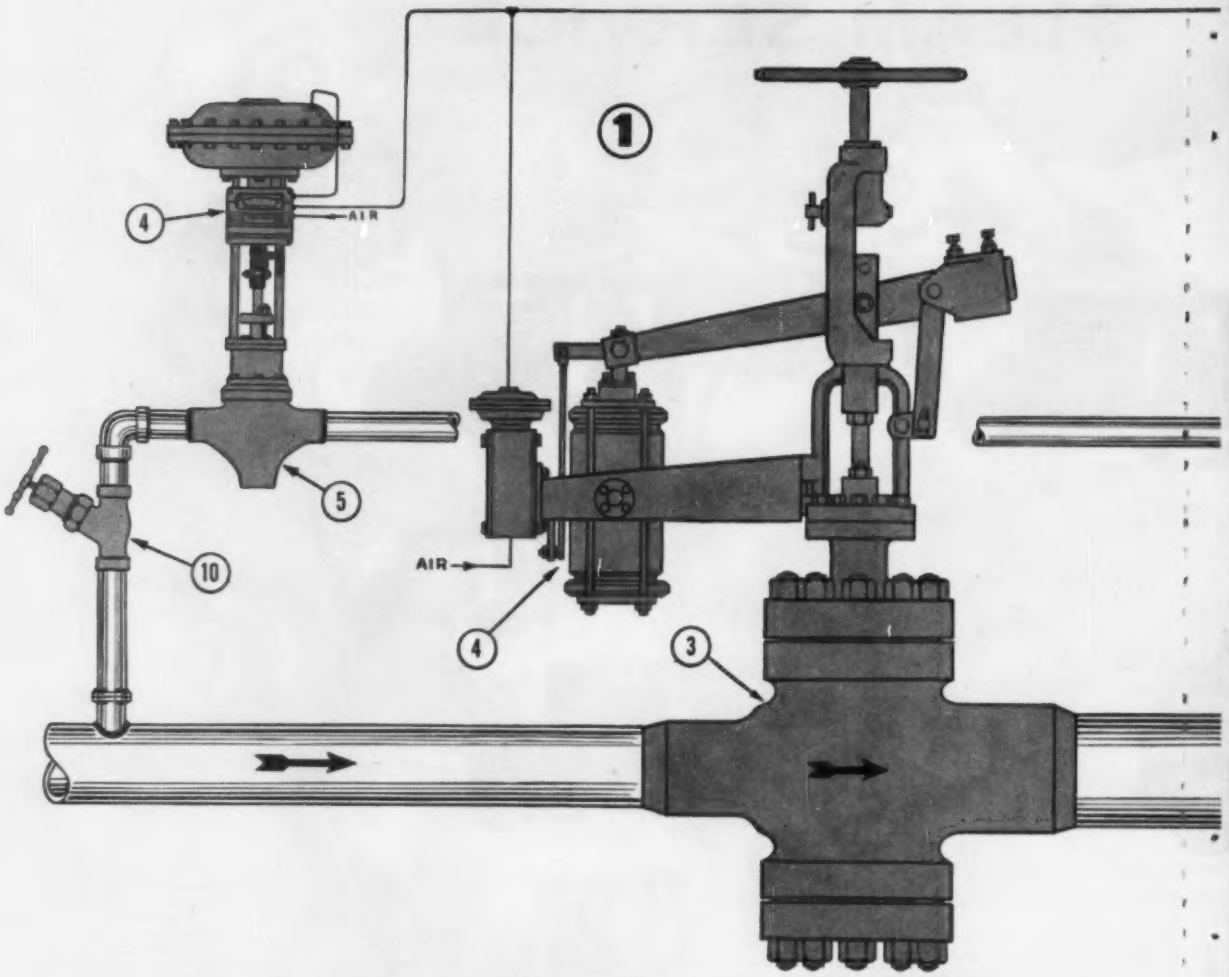
Address _____

City _____ Zone ____ State _____

Clayton MANUFACTURING COMPANY

465 North Temple City Blvd., El Monte, California

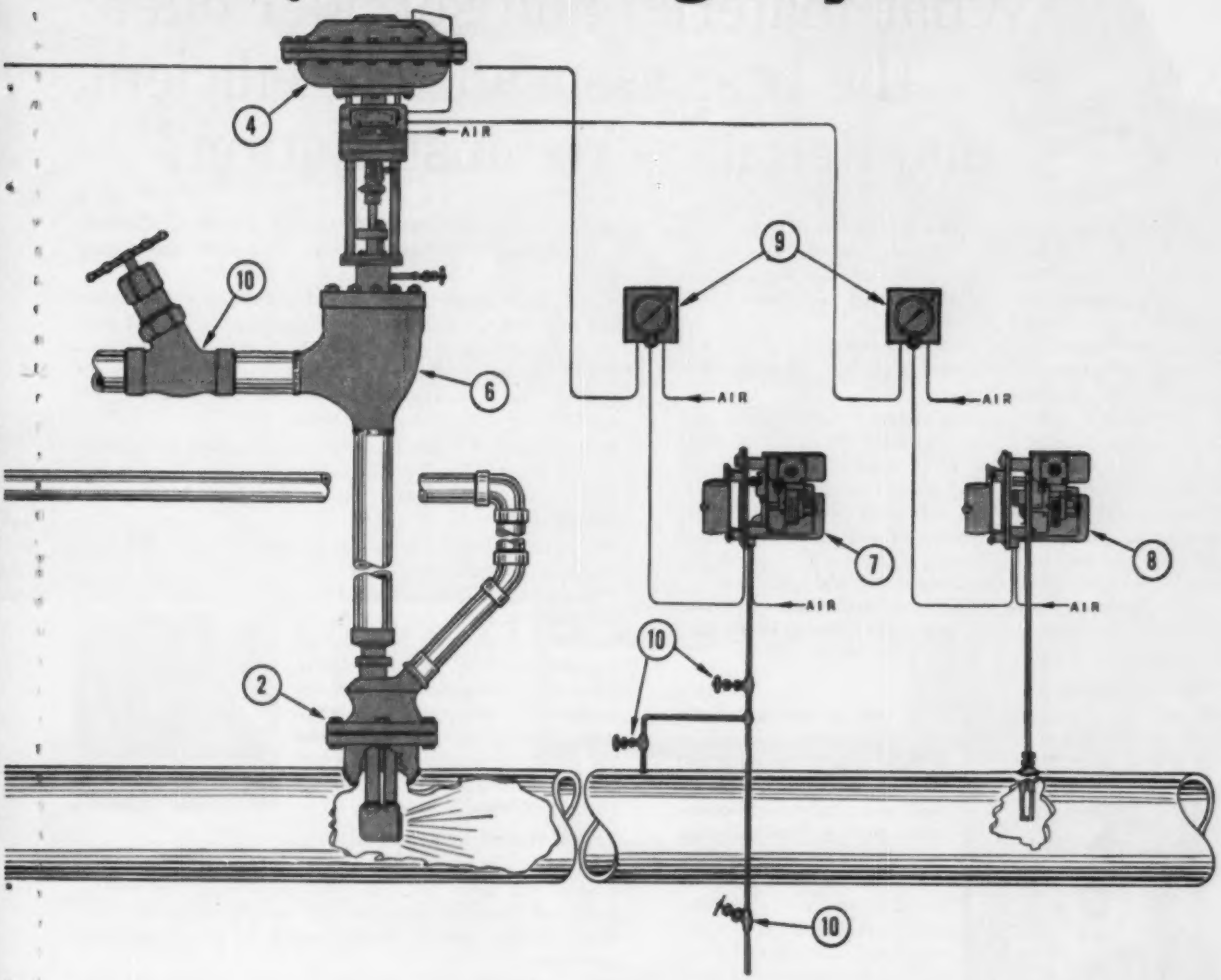
Pressure Reducing and



Complete package

1. SYSTEM ENGINEERING BY _____
2. STEAM ATOMIZING DESUPERHEATER BY _____
3. PRESSURE REDUCING VALVE BY _____
4. POSITIONERS AND DRIVE UNITS BY _____
5. ATOMIZING STEAM CONTROL VALVE BY _____
6. WATER FLOW CONTROL VALVE BY _____
7. PRESSURE CONTROLLER BY _____
8. TEMPERATURE CONTROLLER BY _____
9. CONTROL STATIONS BY _____
10. STOP AND BLOW-DOWN VALVES BY _____

Desuperheating System



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For full details on how a Rockwell-Republic pressure reducing and desuperheating system can benefit you, contact the Republic Engineer in your area. Or, write to Republic Flow Meters Company, Subsidiary of Rockwell Manufacturing Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada Ltd., Toronto.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

For more facts circle 859 on Reader Service card, p 207

If you specify underground hot pipe insulation, ask yourself this question:

What material and supplier offer the best assurance of efficient, maintenance-free installation?

Every engineer knows that his reputation depends upon planning projects that will assure the best performance for the lowest price. He also knows that the *initial* cost is not the *lowest* cost, if the job isn't designed to function efficiently over an extended period.

That's what makes the answer to the question posed in the headline of timely importance where underground hot pipe insulation is concerned.

The use of a central heating system to heat all buildings of a college, housing project, hospital or industrial plant can effect a notable saving in equipment and operational costs. But planning the underground piping for such systems involves many time-consuming problems. Proper insulation, prevention of corrosion and electrolysis, temperature and terrain conditions, and other factors require careful analysis before trenches are dug and pipes laid.

Now, for your honest appraisal and evaluation, we would like to tell you about GILSULATE and the extra benefits which you and your clients will derive from its use.

What is GILSULATE?

GILSULATE is a naturally-occurring mineral which, because of its unique chemical and physical properties, is ideal for the insulation and protection of underground hot pipes and systems. It resists attack by acids and alkalies, is impervious to mold, rodents and plant growth, and is water-resistant.

The thermal efficiency, low installation cost and long service life of GILSULATE are supported, not alone by extensive laboratory and field research, but also by years of successful use in thousands of installations around the world.

What about Engineering Service?

American Gilsonite Company believes that good service is as important as the physical benefits of GILSULATE. It is as important to the company's reputation that the product be used properly, as it is for the engineer to assure his customer of an efficient, economical installation. That is why American Gilsonite Company provides these extra engineering services:

1. *Design Assistance*—American Gilsonite's carefully selected and franchised distributors all employ mechanical engineers with extensive experience in heating and air conditioning. They will work with you in preparing underground piping plans, checking soil conditions and arranging for supervision of the installation work.

2. *Approval of Plans*—Plans and specifications for all jobs should be checked by American Gilsonite's Engineering Dept. This cost-free service prevents trouble before a job is started.

3. *Supervised Installation*—Every GILSULATE installation of 30 tons or more is supervised by an American Gilsonite field service representative who stays on the job until it is completed. Smaller jobs are inspected by the distributor. This is an assurance to everyone concerned...owner, architect, engineer, mechanical contractor, and the materials supplier...that every step of the job will be exactly according to specification.

Tried, Tested and Proved

The GILSULATE system of insulating and protecting underground hot pipes has been used successfully by federal, state and municipal governments, leading industries, utilities, hospitals, public housing, religious and educational institutions.

Without obligation, we will be pleased to send you technical information on GILSULATE insulation so you can evaluate the merits of this low-cost, poured-in-place material.

Ask to have your name put on the mailing list for PIPE INSULATION NEWS. The Summer 1960 issue tells how and why Caterpillar Tractor Co. used 2100 tons of GILSULATE in their Mossville, Ill., plant. Also, a story of how owner-conducted tests proved the superiority of GILSULATE over prefabricated conduit insulation.

FACTS ABOUT GILSULATE

1. **Easy-to-use**—just pour, shovelpoint and tamp...pipe heat does the rest.
2. **Forms protection against heat loss** and all hazards commonly encountered by buried hot pipes.
3. **Needs no housing or mechanical sheaths:** no mixing, special handling or equipment.
4. **Only needs normal pipe spacing:** for multiple pipe or cramped conditions.
5. **Four types available:**
   Type A for 220-300° F. temp. range
   Type B for 300-365° F. temp. range
   Type Special B for 365-420° F. temp. range
   Type C for 420-520° F. temp. range

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF UNDERGROUND HOT PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY

Municipal Airport P. O. Box 15, Salt Lake City, Utah
Affiliate of Barber Oil Corp. & Standard Oil Co. of California
Distributors in Principal Countries of the World

For more facts circle 860 on Reader Service card, p 207

For more facts circle 861 on Reader Service card, p 207

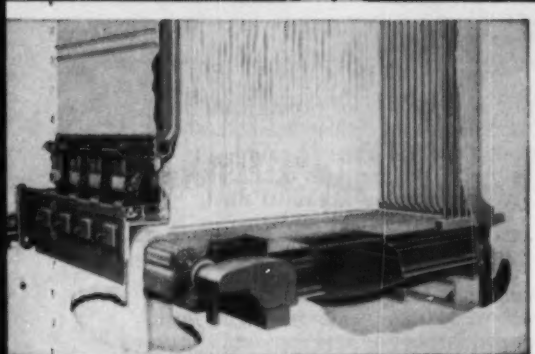
Let's take a NEW LOOK at spreader stoker firing

particularly

DETROIT ROTOGRATE

stoker advantages

One of five Detroit RotoGrate Stokers assembled before shipment to a mid-west public utility.



Detroit RotoGrate Stoker with two of the six Rotors removed to show the overlapping highly restricted grate designed especially for spreader stoker firing.

• Contact our nearest District Office or your consulting engineer.

- **High Burning Rates** per square foot of grate area permit continuous operation with less expensive boiler and furnace design
- **Low Carbon Loss** results in high over-all efficiency
- **Superior Design** permits operation with low excess air
- **Wide Load Range** handled smokelessly with convertible grate area
- **Low Maintenance** compared to other coal-burning methods.
- **Burns All** bituminous coals and Lignite. Also bark, wood, bagasse and other refuse fuels, either separately or in combination with coal

Backed by over a half century of experience. Complete manufacturing and service facilities.

DETROIT STOKER COMPANY

DIVISION OF UNITED INDUSTRIAL CORPORATION

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

Steam trap dependability is a matter of what the manufacturer puts into the trap

ARMSTRONG TRAPS ARE DESIGNED AND MADE TO GIVE YOU DEPENDABILITY

1. Efficient, proved operating principle

Armstrong Traps provide the most advanced development of the time-proven inverted bucket principle. Simple, but effective, there isn't much that can go wrong.

2. Good design

Armstrong Trap design gives big capacity in a small package. The mechanism is virtually fool-proof. All body styles are easy to inspect and maintain without removal from the line.

3. Highest quality materials of construction

Only the best goes into Armstrong Traps. Bodies are close grained 30,000 tensile iron castings or high quality forgings. Working parts are all tough, corrosion resistant stainless steel.

4. Good workmanship

Armstrong Traps are made by craftsmen who take pride in their work. Careful inspection and frequent checking insure the quality of the trap.

5. Application know-how

Your problem has probably been solved already in the extensive experience of the Armstrong engineering and sales organization. You can be sure of sound, dependable recommendations.

Your local Armstrong Representative can show you what Armstrong dependability can do for you. Call him today or write direct.

860 Series for low pressure heating service.

800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.

The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS

8121 Maple Street Three Rivers, Michigan

For more facts circle 862 on Reader Service card, p 207

circle 863 on Reader Service card, p 207 ➤

A BRAIDED ASBESTOS PACKING

STYLE 804

To Withstand High Pressure Superheated Steam or Hot and Dry Gases

Stays Soft and Resilient

You will find many uses for this superior Anchor braided asbestos packing, which is available in ring, spiral and coil. It is known to industry as 804 packing.

Ankorite 804 is a pure asbestos graphite plastic core packing having an outer jacket of closely braided high quality asbestos yarn. The jacket is reinforced with monel metal wire.

As Ankorite 804 will stay soft against high pressure and high temperature conditions, it is the ideal packing against high pressure, superheated steam, or for hot and dry gases, as well as many other uses.

For further details on Ankorite 804, write us today.

DISTRICT OFFICES

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THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
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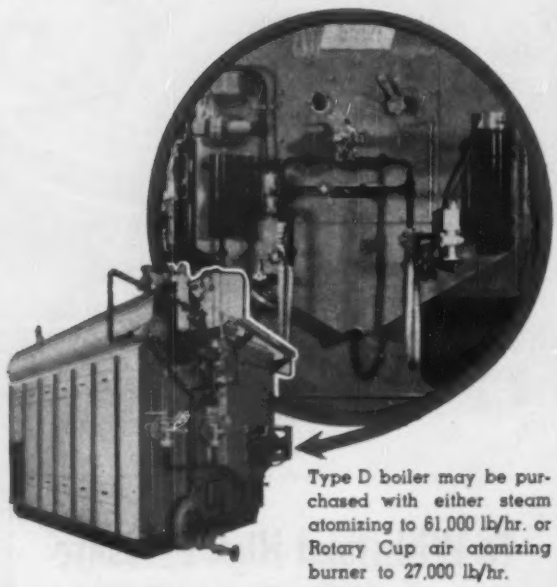
FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

automatic firing fronts.....

Part of the package *with*

SUPERIOR
PACKAGED BOILERS

for RESIDUAL FUEL OILS



Type D boiler may be purchased with either steam atomizing to 61,000 lb/hr. or Rotary Cup air atomizing burner to 27,000 lb/hr.

Type AS boiler is supplied with either Rotary Cup or Steam atomizing for entire range of boiler capacities.

The efficient firing front of a Superior Package Boiler is much more than a mere burner . . . it is an integrated burner with its associated controls combined with an air register designed to provide proper velocities and turbulence as well as an air-cooled firing front which is both accessible and uncluttered.

Superior's air register itself is unique as a result of Superior's rear-mounted draft fan . . . providing both an air-cooled furnace floor (Type AS) or furnace roof (Type D) and a static to velocity head change which assures undistorted combustion.

Burner equipment is dictated by your operations. *Single steam atomizing burners* **are provided for capacities to 46,000 lbs/hr. with positioning or metering controls. For greater capacities, twin burners with metering controls provide an extended range of operation with greater safety.**

The steam atomizing burner illustrated, shows shut-off valves, recirculation feed control, fuel temperature control and atomizing steam qualifier . . . neatly assembled at firing front for maximum performance, safety and availability.

Rotary-cup, air-atomizing burners **with positioning controls are supplied for capacities to 27,000 lbs/hr. Controls may be in integrated console or separate free standing panel. This burner provides efficient fully automatic operation burning residual fuel oils with supervision.**

The rotary burner illustrated is mounted on a forced-draft windbox with triple channel air supply, has self-contained atomizing air fan and automatic fuel temperature control. This arrangement provides maximum flexibility combined with economy and safety of operation.

Their unique firing fronts are but one of the many exclusive features which make Superior Packaged Boilers outstanding in their field. If you'd contemplate the purchase of a boiler, it will pay you to investigate. Write for Catalog ASD-11.

Specialists in PACKAGED BOILERS . . . exclusively

SUPERIOR COMBUSTION INDUSTRIES, INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
PACKAGED BOILERS

For more facts circle 864 on Reader Service card, p 270

Your service center for FREE data

Either of the no-postage Reader Service cards below and p 207B will bring you FREE valuable additional information on any item listed in the Equipment and Design Aids Roundup and on any advertised product appearing in this issue. Here's all you need do to get this information:

- **Study New Equipment** described in the roundup starting on p 209. Circle numbers on card corresponding to items listed
- **Check Design Aids** surveyed, beginning on p 209. To get your personal copies use the card below
- **Read advertisements** and note number listed under each ad. Circle ad numbers on card for complete details
- **Print your name and company on front of card**

October 1960 issue **Circle numbers below for FREE data** Card void after April 1, 1961

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Engineer's bookshelf . . A selection of late publications

Elevators, Third Edition. *By F A Annett, 376 pp, hard cover, $11.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y.*

Reviewed by Jack Nelson Millar, Millar Elevator Industries

Earlier edition of this book by the late Fred Annett served as a basic reference. For some 30 years it had been almost indispensable. Although the new edition is most thorough in its content coverage, it is almost an impossible task to include enough detail in any one book to fully meet the needs of today's specialists.

Most of the data relevant to obsolete equipment has been eliminated in this new edition. In its place will be found considerable detail on modern elevator controls. This book should be required reading for all those really interested in elevator technology.

Had Fred Annett not died during final preparation of the book he probably would have included even more on the newer elevator drives, patented innovations, basic group-system comparisons, automatic-car-door operators. Further detail on these subjects would have improved the book.

It is hoped this great work will be carried on by someone as competent as Fred since we can already anticipate need for the next revision. His successor should be one who will carry on where he left off, using his easy-to-read, easy-to-follow technique.

Fluid Dynamics and Heat Transfer. *By J G Knudsen, Prof of Chemical Engrg, Oregon State College, and D L Katz, Chairman, Dept of Chemical and Metallurgical Engrg, University of Michigan. 576 pp, illust, $12.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

This volume aims to bridge the gap between fluid-flow and heat-transfer theory. Material proceeds from first principles through practical formulas used in design, for a perspective including both theory and practice. Basic differential equations of fluid flow are developed, then applied to ideal flow, laminar and turbulent flow in closed conduits and past immersed bodies, heat-exchanger flow.

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Selected Semiconductor Circuits Handbook. *Edited by S Schwartz, President of Transistor Applications, Inc, 506 pp, $12.00. John Wiley & Sons, 440 Park Ave S, New York 16, N.Y.*

Over 150 semiconductor circuits, both computer and communications types, are discussed in this handbook. Emphasis is on "building-block" type of circuitry. Some of the many subjects treated: amplifiers, oscillators, switching and logic circuits, power supplies, power converters.

Each chapter starts with a section on design philosophy; groups of selected circuits form chapter topics. Memory circuitry and its specific problems take up a full chapter.

Centrifugal Pump Application Manual. *Buffalo Forge Pumps Div of Buffalo Forge Co, 227 pp, $5.00. Buffalo Forge Co, Dept 46, 490 Broadway, Buffalo, N.Y.*

Handbook should help pump users understand pump operation, selection and general forms and types of centrifugal pumping equipment. It treats principles of centrifugal-pump operation, factors involved in handling many liquids under differing conditions. Viscosity effects, cavitation and suction lift, temperature rise in pumps, packing and seals, installation and troubleshooting are discussed and illustrated. Data includes reprints of appropriate sections of the Hydraulic Institute Standards.

Welding Handbook, Third Section, Fourth Edition. *512 pp, 335 illust, 78 tables, cloth, $9.00. American Welding Society, 33 W 39th St, New York 18, N.Y.*

Need to widen scope of *Welding Handbook* because of recent developments in industry and advances in joining technology is filled with this third section covering adhesive bonding and welding of plastics. Section also covers ultrasonic welding, metal-joining and arc-cutting processes. The new tabulated material will aid eventual compilation of standards.

Other topics include forge, thermit and induction welding, surfacing, metallizing, brazing, soldering, welding by cold working and stud welding.

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BOOKSHELF continued

Gas Turbine Power, Second Edition. *By G M Dusinberre, Prof of Mechanical Engrg, and J C Lester, Assoc Prof of Mechanical Engrg, Pennsylvania State University. 334 pp, illust, hard cover. International Textbook Company, Scranton 15, Pa.*
As in the previous edition, the gas turbine is considered as a versatile prime mover with many applications Free-piston gas turbines, g-t automobiles, closed-cycle g-t nuclear power reactors are part of the new material covered in this revision.

Designed to give a sound knowledge of principles of analysis and design of the gas turbine, volume emphasizes thermodynamics and heat balance. Basic cycle and its variations, gas flow, compressors, combustion, part-load operation are some chapter headings. So you can follow examples in the text, an appendix excerpts the Keenan and Kaye *Gas Tables.*

Professional Engineer's Examination Questions and Answers. *By William S La Londe Jr, 589 pp, $7.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y.*
This book was written as a guide to help qualified candidates pass license examinations. Questions and answers prepared by an examination expert indicate the type that will be asked. The questions also serve to point out areas where the candidate may need some improvement before entering the examination room.

Over 600 questions in the book were selected from recent exams for the PE license, the Land Surveyor license and the Engineer-in-Training certificate. For every question there is a detailed answer—the type examiners accept and credit. More than 100 questions have been added to this second edition to broaden coverage in line with recent examination trends.

Plumbing, Heating, and Piping Estimators' Guide. *By Paul G Davis, 208 pp, 94 illust and tables, $6.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y.*
This estimators' guide gives tested methods of turning out complete, accurate estimates for all types of plumbing, heating and piping work. Methods use detailed summary sheets; all factors bearing on work estimate are listed—including materials, labor and miscellaneous costs—so none are overlooked. Items of overhead are covered in detail.

Book explains methods of determining average hourly rates, including such cost elements as overtime and travel pay.

Over 70 "labor-factor" tables are included for various elements of the work involved. Each table gives data for a range of efficiency factors to be based on local labor conditions.

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3 Equipment and Design Aids roundup

General equipment and key materials

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- Valves, piping, fittings — 225
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Steam and hot-water systems — 296

Liquid-handling systems — 306

Nuclear systems — 312

Gas systems — 314

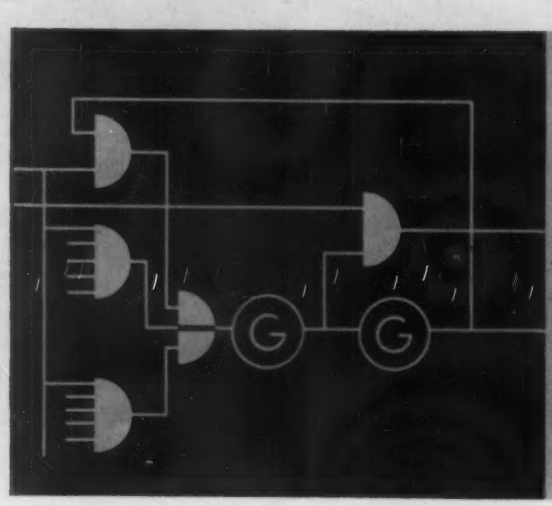
Equipment selection starts with knowing what can be had to do the job on hand. So before you can finalize on a specific piece of equipment to fit into an energy-system design, you need up-to-the-minute data on products available. For this reason we've carefully sifted the wealth of information made available to us over the past 12 months. Result: a selective survey of today's equipment and design aids, plus editorial analysis of trends.

This roundup is organized for your convenience—by systems. Under the headings *Liquid handling, Gas, Steam and hot water, Electrical, Mechanical transmission, Air conditioning, Nuclear,* we've subdivided equipment by type and use. System-spanning items are listed under the heading *General equipment and key materials.*

Suppose, for example, you're looking for what is new in steam-service valves. You'd turn to *Steam systems* and look under the subhead "Valves, piping and fittings." But a valve for water or oil would be listed under *Liquid handling.* To look over the multipurpose valves, you would check through the *General equipment* pages.

We hope this systems-oriented roundup will prove a valuable tool in plant design for your year ahead.

GENERAL EQUIPMENT AND KEY MATERIALS



Fully automatic control appears in many areas of energy systems. With several fully automatic central stations due to start up in the next year, many manufacurers are spending much time and capital developing components for these systems.

As an offshoot of this development work, new primary elements, control drives and indicators are appearing on the market. These new components will offer improved operation.

Solid-state instruments and controls continue to expand their application in all energy systems. Difficulties with solid-state components—heat sensitivity and low power level—have been overcome.

Out of the lab, into the plant come new instruments for micromeasurement of air pollution.

L. E. Stuart

Associate Editor

Instrumentation equipment designs

1 **Supervisory equipment** releases valuable operating personnel from routine duties, can be applied to any situation demanding remote metering, monitoring or control. System uses transistors, diodes and other solid-state elements in place of relays. These devices act like mechanical switches—hundreds of tie-pin-size transistors and diodes on transistorized cards direct and receive operation messages to and from remote apparatus through a master-station-remote-station hookup. Cards with no moving parts take an impulse originated by touching a button or an electronic connection and convert it into an outgoing code. Equipment is designed to operate on any 2-way communication channel.—General Electric Company

2 **Digital computer** PB250 combines a large, expandable memory and versatile command structure with computing speed in the microsec range. You can put this computer at an engineer's deskside or on the line for process monitoring, control, data logging and alarm generation. It's a serial, binary single-address unit with an internally stored program. Reliability is assured through its conservative solid-state design, small component count and absence of moving parts, maker says.—Packard Bell Computer

3 **All-solid-state** load- and frequency-control system's modular units do away with moving parts. Transistors and other solid-state devices result in space savings, reduce heat dissipation by a factor of 15, according to maker. Heart of the system is the control amplifier, a dc differential amplifier performing computing, measuring and controlling functions. This replaces slidewire servo, is available in three types.—Brown Instruments Div of Minneapolis-Honeywell Regulator Company

4 **Solid-state process computer** system provides data for on-line operation and analysis, off-line analysis and off-line analysis using on-line data. Stored data constants and operating programs can be modified or corrected while machine is running without disturbing remaining program or stored information. Plain English and decimal-system control panel eliminate decoding.—Information Systems, Inc

5 **Binary digital** high-speed supervisory and telemetering system has capacities up to 2048 points. Transmission speed is adjustable, system-error-monitoring features are included. Power supply for master- and slave-station ends of system can be from station-battery or 115-v-ac 60-cycle single-phase supply.—Industrial Process Engineers

6 **Portable ultrasonic thickness gage** uses pulse-echo method of detecting changes in thickness to spot flaws and small discontinuities in metals and other materials. No larger than a portable radio and weighing ten lb, versatile gage uses transistors and low-voltage batteries. It's said to be explosion resistant. Measurements may be read directly on a calibrated meter—no bother of interpreting them through oscilloscope and charts. Operator adjusts the "material" dial for metal being inspected and instrument reads directly in inches. Accuracy is within 1% of full scale. Over 3-ft maximum thickness can be gaged in aluminum and steel; minimum thickness is .060-in. aluminum and .070-in. steel.—Sperry Products, Inc

7 **Pneumatic indicating transmitters** for pressure, flow, temperature, liquid level, differential pressure and dew point feature measuring elements specifically designed for each major process variable. Instrument components are enclosed in a weatherproof steel case with corrosion-resistant vinyl-coated gasketed door. —The Foxboro Company

8 **Pneumatic transmitting rotameter** for air-signaling fluid-flow rates to remote recorders and controllers has magnetic design. This provides evenly distributed magnetic field without drag on the metering float.

Four calibration adjustments permit field recalibration whenever basic operating conditions change.—Schutte and Koerting Company

9 **Function generator** boasts accurate readout. Compact unit provides pneumatic output that varies as a prescribed function of a pneumatic input. Principal use is in linearizing the signal from a differential-pressure type flow transmitter. You can use it to measure and control feedwater or steam flow in power production, maker suggests. Air consumed is 0.2 scfm, input and output—3 to 15 psi pneumatic.—Taylor Instrument Co

10 **Pneumatic safety control** senses pressures to 2000 psi. Suitable for unattended machinery, system operates through small captive charge of compressed air. Basic elements are hand-charging unit, pressure-sensing valve with charge-air gage, temperature-sensing valve, actuating unit. Sensitive to wide range of temperatures and pressures, system will also work almost any type of pilot-operated valve, switch, warning or other control.—California Controls Co

11 **Air-adjusted pressure pilots** feature control accuracy to within ½ psi from positive pressures through vacuum range to 30-in. Hg. Remote air loading of the pilot, by locating pressure-adjusting panel at any convenient distance from the regulator, makes centralized control possible. You can save on fuel and get greater control stability by mounting the pilot at the valve. Economical use of adjusting air is assured since air is bled only when the setting is changed.—Spence Engineering Co, Inc

12 **Electrical differential-pressure gage** can detect pressure differences as small as 0.0001-in. H_2O. Range is from zero to .01-in. H_2O. Operating on 115-v 60-cycle ac, sensing device is metal thermopile installed in flow tube. Unit can be used with remote recorders, can be calibrated in mass flow.—Hastings-Raydist, Inc

13 **Pneumatic wide-band relays** for control-system square-root extracting and squaring employ null-balance-vector mechanism. Relays extract square root down to 10% of input span and 1% of output span—input and output ranges are 3 to 15 psig with air consumption of 0.2 scfm, nominal error of 1% of output span. High-grain integral pneumatic amplifiers simplify piping, reduce number of air sets per system and air consumption.—Republic Flow Meters Company

14 **High-pressure** 6-in.-dia gage is available in twelve ranges to handle applications from 1000 to 100,000 psig. Multiturn helical bourdon tube of special drawn-and-formed 316 stainless steel gives longer life, greater accuracy. Divisions of dial are spread over 300 deg in all ranges for maximum readability. Safety features include high-tensile plate between element and viewer and a laminated dial glass. Movement is of stainless steel throughout.—Astra Corporation

15 **Pressure transmitter** was designed to meet needs for accurate measurements in lower-pressure ranges. High-level output signals can be delivered up to 1.5-v ac or up to 100-millivolts dc with accessory demodulator. Standard ranges available: from 0 to 1.5 psi to 0 to 60 psi with intermediate ranges and accuracies of up to ± 0.15% of full range. Operates in corrosive environments.—International Resistance Company

16 **Subminiature pressure transducer** permits easy stacking. Unit features range of 0-5 to 0-5000 psia, 7-v dc or ac excitation, provides 42- to 56-mv nominal output. Series includes absolute gage and bi- and unidirectional differential-pressure transducers. Compensated temperature range is –65 to 250 F, ambient temperature limits –100 to 275 F.—Statham Instruments, Inc

17 **Pressure detector** in combination with monitor operates to 3000 psi, converts pressures from in. Hg directly to an electrical resistance. Pressure-sensing element linearly varies terminal resistance of low-temperature-coefficient alloy winding, permits operation over 32- to 150-F range. Size of Model 328 is 2 5/16 x 2⅛-in. with ¼-in. standard pipe-thread inlet.—McGraw-Edison Company, Instrument Div

18 **Battery-operated transistorized gages** range from zero to 1000 microns, zero to 20 millimeters Hg. Portable or panel-mounted models have high accuracy, rapid response. They give continuous, practically instantaneous measurement of gas pressure under vacuum. Units have matched interchangeable-gage tubes, sealed meter and spring-loaded on-off switch — switch prevents battery drain when instrument is not in use.—Hastings-Raydist, Inc

19 **Heavy-duty geared-movement** pressure gage is designed for wide range of applications. Recommended for oil, water, steam, gas or any other media not corrosive to brass or bronze, unit is said to eliminate inaccuracies in pressure readings resulting from any distortion of piping. Install it by hand-turning the gage case. Unit comes with heavy-duty drawn-steel case, friction type snap-on ring beaded for lens protection.—American Chain and Cable Company, Helicoid Gage Div

20 **Temperature-pressure recorder** features better readability. Redesigned 12-in. recorder has recessed bottom permitting one type connection for both wall and panel mounting. Extra-large "in" door improves recording-chart visibility. Filled-system thermometer elements measure temperature from –300 to 1200 F; pressures from 30-in. Hg of vacuum to 25,000 psi are recorded. White window skirt on door gathers light for improved readability of chart records.—American Machine & Metals Inc, United States Gauge Div

21 **Span-adjustable zero recorder** covers one to 250 mv. Null-balancing unit uses line-driven synchronous converter and amplifier to control 2-phase motor rebalancing measuring circuit. Mv input converts into visual indication and permanent chart record. Chart speeds can be changed quickly, adapting unit to wide variety of processes.—Daystrom, Inc, Weston Instruments Div

22 **Bellows meter** for flow and liquid-level applications that don't require recording or transmission boasts 6-in. indicating dial. Equipped with stainless-steel pointer pinion, mercuryless meter measures 15 differential ranges of water from 0-20 to 0-400 in. Nylon-faced gear sector stretches instrument's life in measuring pulsating flow. — Minneapolis-Honeywell Regulator Company, Brown Instruments Div

23 **Electronic wattmeter** takes measurements at sustained accuracy and resolution down to .01% of rated input.

continued

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Low-impedance-dc output also allows unit to actuate digital meters, drive strip-chart recorders. Range is 250, 500, 1000 w. —Daystrom, Inc

24 **Adapter** lets you measure temperatures at varying immersion depths with fixed immersion thermocouple. You can adjust metal-sheathed tubular type thermocouple to spring-loaded thermocouple with any desired immersion length from 1-in. min. It's made with stainless-steel sheath, nickel-plated brass compression fittings. — Thermo Electric Company

25 **Recorders** allow installation of warning signals or control of processes without duplicating instruments. They can be equipped with either one or two set points for maximum-minimum control. There's no interference with writing pen since on-off contacts are inductively coupled to transistorized control circuit by vane attached to pen arm. You can fix maximum set point in any position over range of 30 to 100% of full scale, minimum set point between 0 and 70% of full scale.—Curtiss-Wright Corp, Princeton Div

26 **Electroluminescent instrument dials** featuring silhouette clarity and extra-long life light up panel instruments. Illuminated dial face is backed by a lamp base—a vitreous-enameled steel sheet coated with electroluminescent phosphor.—Daystrom, Inc, Weston Instruments Div

27 **Pocket microscope** checks, measures small parts. No larger than a fountain pen, it has glass-etched reticle to measure 1/10 x .001-in. divisions. Use it to check and measure small parts for detecting flaws, quality control—no calculations necessary.—Edmund Scientific Company

28 **Instrument-valve manifold** combines three valves in a single body; two provide line shutoff, the other equalizes pressure to protect instrument's internal working parts. Connection tap calibrates high pressure. Manifold should provide simpler and more dependable means of connecting flowmeters, level indicators, other instruments.—Yarnall-Waring Company

continued

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BJ Boiler Feed Pumps

Reliability is the only real "bargain" you can afford in a boiler feed pump. Reliability that comes from the basic quality built into a pump, and the reliability that assures long, continuous performance under all conditions.

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BJ Quality does cost less in the long run!

Baltimore Gas and Electric Company *adds four more BJ Double-Case Boiler Feed Pumps to 22 already installed. One new 7200 HP unit will deliver 3035 GPM with 3290 PSI discharge pressure at 342 degrees F.*

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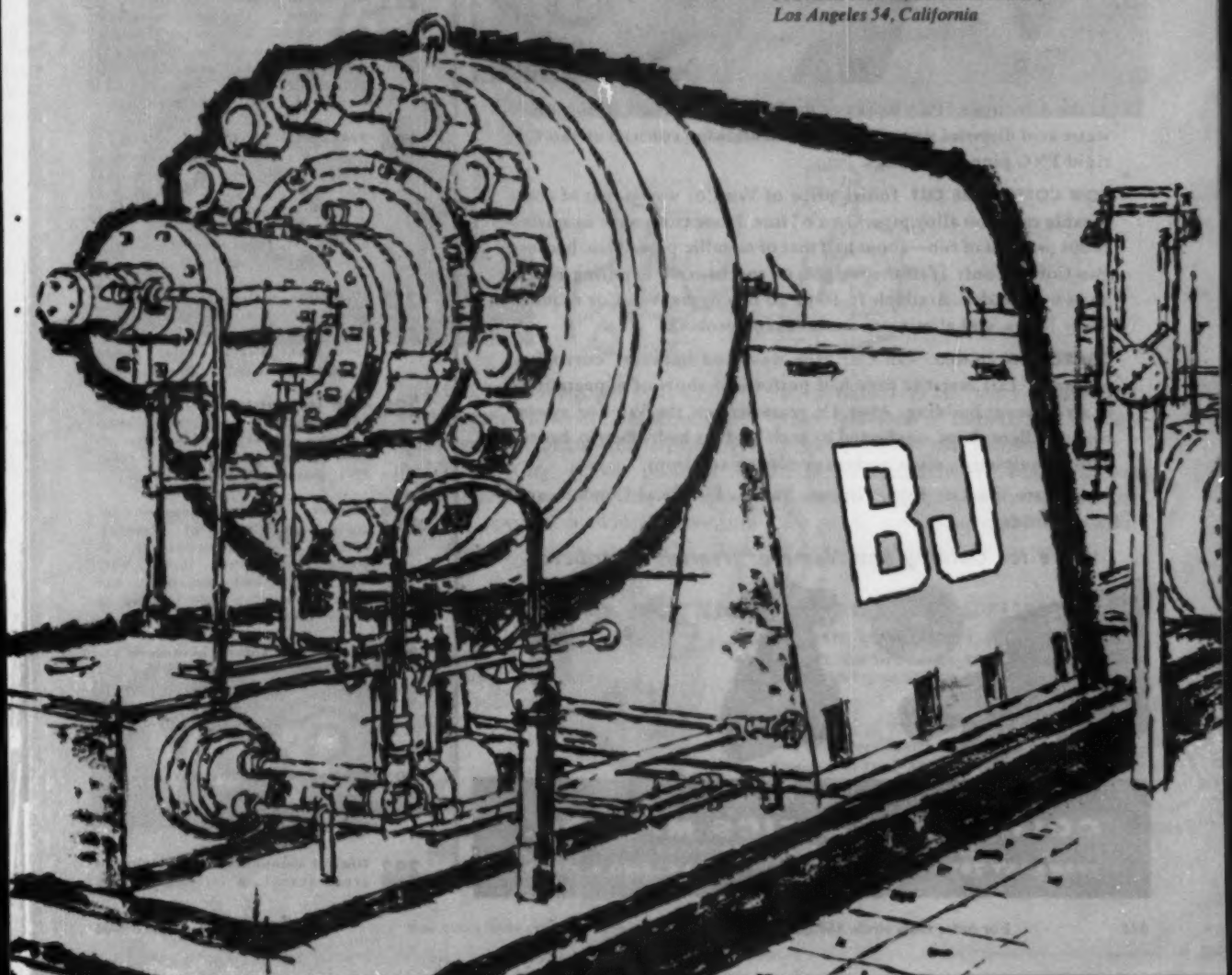

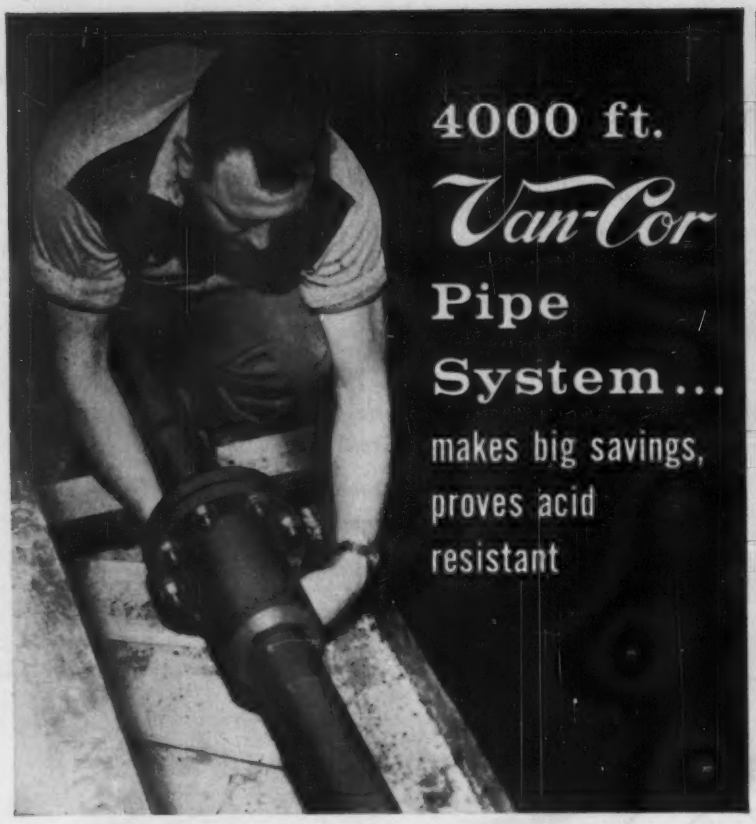

At the Allentown (Pa.) Works of the Western Electric Co., the entire waste acid disposal system in the recent addition consists of Van-Cor rigid PVC pipe and fittings.

HOW COSTS WERE CUT. Initial price of Van-Cor was ⅓ that of comparable cast iron alloy pipe. On a 6" line, labor costs were estimated at 29¢ per foot of run—about half that of metallic pipe. Also, because Van-Cor has only 1/10 the weight, no mechanized handling equipment was needed. Available in 10 or 20 ft. lengths, Van-Cor requires fewer joints, and eliminates the breakage problem.

CORROSION LICKED. Van-Cor pipe was used because "corrosion resistant" cast metallic pipe had performed short of expectations in an adjacent building. After 1½ years service, the Van-Cor system is in excellent shape, unaffected by such acids as hydrofluoric, hydrochloric, sulphuric, nitric and many plating solutions.

Investigate Van-Cor Pipe, Fittings, Valves, Electrical Conduit, and Fabrications . . .

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Instrumentation

Begins on page 210

29 **Cathodic protection** goes automatic with control to automatically adjust current according to corrosion rate. It continuously indicates state of submerged structure and retards coating deterioration. While conserving power and anode material, control keeps dc rectifier from overloading. Applications include pipeline, condenser-waterbox installations.—Electro Rust-Proofing Corp

• Instrumentation

Just circle key numbers on the Reader Service card, page 207, to get complete product story

285 **Recording systems** for transmitting data to distant computer facilities via telephone circuits, firm's approach to industrial-process-control systems are covered in two bulletins. Daystrom, Inc, Control Systems Div

286 **Transmitter and receiver** equipment for remote temperature control is introduced in bulletins 371, 371-1, 371-2. Transmitter transduces temperature measurement into a 3- to 15-psi air-pressure signal from remote location. The Powers Regulator Company

287 **Pneumatic transmitters** for measuring level over range of 1- to 2000-in. H_2O are covered in 4-p spec sheet P31-1. Bailey Meter Company

288 **Flow transmitters** extract square-root function producing signal varying linearly with rate of flow. Details are in spec sheet 22-1. Bailey Meter Company

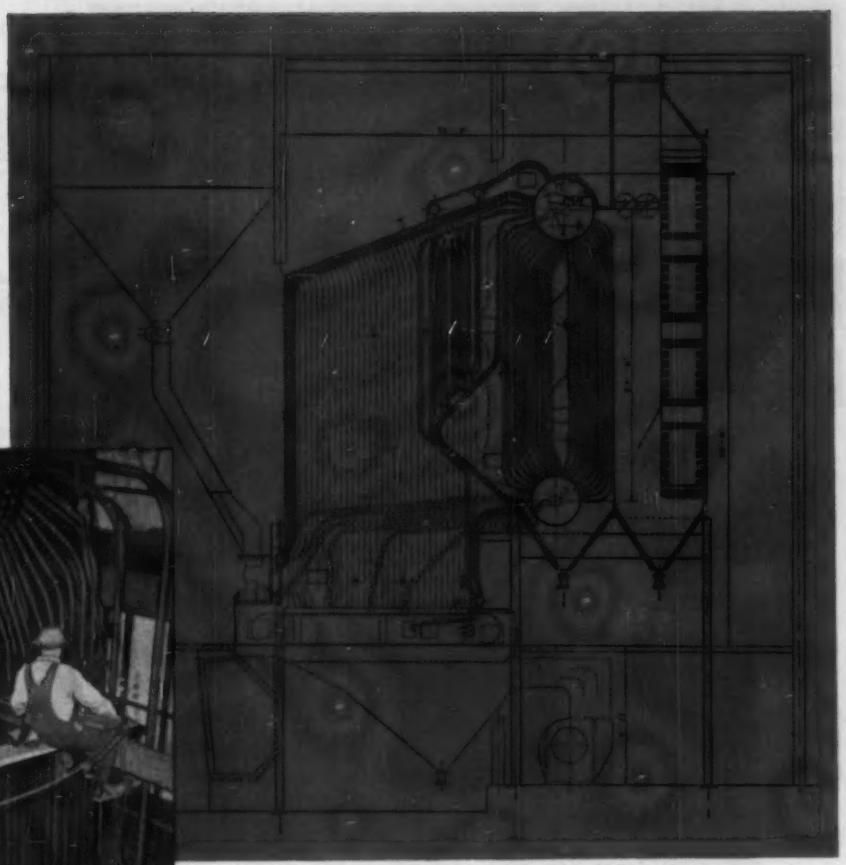
289 **Mercury - switch - equipped** controls for differential pressure, single - stage temperature, 2-stage temperature, liquid level and mechanical movement are featured in 52-p 1960 catalog of firm's line. Mercoid Corporation

290 **Linear and rotary actuators** are featured in 16-p bulletin J-105 which covers 20 sizes delivering torques from a few in.-oz to 3500 in.-lb. Jordan Controls, Inc

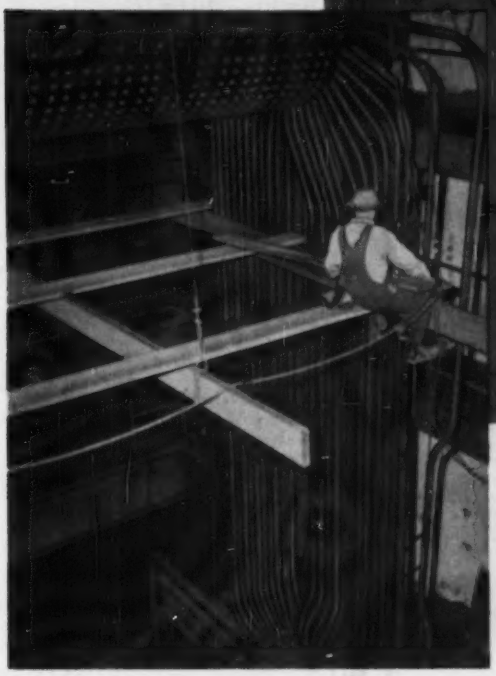
291 **Digital-computer paper-tape** accessories are detailed in data sheet. Bendix Aviation Corporation, Bendix Computer Div

292 **Digital components** and systems are featured in informative 8-p

Union Starch Installs a Modern Coal Fired Steam Generator



Longitudinal section through unit.



Tubes being installed in steam and water drums.

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This 125,000 pounds per hour capacity Vogt Steam Generator, especially designed to burn bituminous coal, serves the Granite City, Illinois plant of the Union Starch and Refining Company. The unit operates at 475 lbs. pressure and delivers steam at 750°F. total temperature. It has water cooled front, sides and roof of furnace and employs a spreader type coal stoker.

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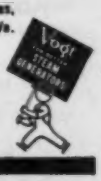
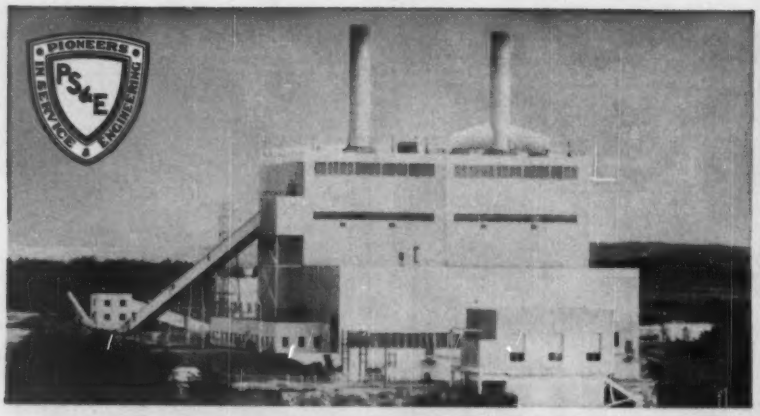
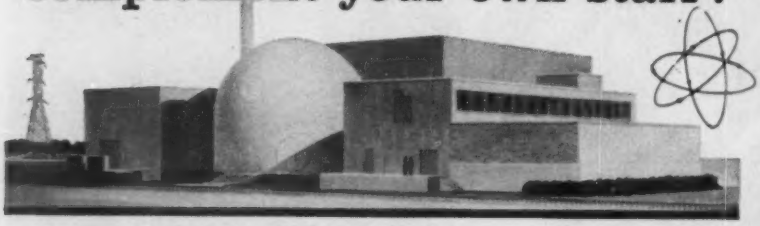


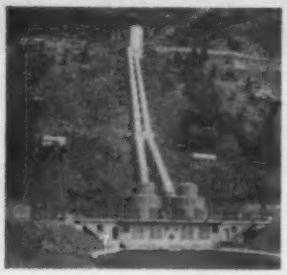
STEAM GENERATORS

For more facts circle 868 on Reader Service card, p 207



Which Pioneer service do you need to complement your own staff?





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Instrumentation

folder describing firm's background and facilities. Technitrol Engineering Company

293 **Supervisory-control system** is outlined in 12-p well-illustrated brochure. Operating sequences are detailed. Electro-Mechanical Research, Inc, Ascop Div

294 **Electronic computing system** is described in 6-p brochure S-483. Royal McBee Corporation

295 **Electronic data-processing** computer system is detailed in 12-p publication CPB-81P. General Electric Company

296 **Shaft-position digital encoders** with magnetic readout are topic of 12-p booklet. Complete specs, operating principles are given. Electro-Mechanical Research, Inc, Ascop Div

297 **Digital information system** is described and well illustrated in handy 8-p bulletin E72-2. Bailey Meter Company

298 **Autographic plotters,** multi-channel type for saving testing time by visual data plotting, are covered in bulletin PG-100. Application data and specs are included. Gilmore Industries, Inc

299 **Data-processing equipment** including digital data processing, analog and digital computing systems is topic of 48-p preliminary technical publication N-07(1). Leeds & Northrup Co

300 **Process-control** information and annunciator systems are topics of 52-p brochure 100C. Equipment photos, charts and diagrams aid choice. Panellit, Inc, Panalarm Div

301 **Thermostats,** adjustable heat regulators and magnetic relays are described with specs in bulletin T-5. Precision Thermometer Instrument Company

302 **Sensing-transmitting instrument** controls pressure or temperature by proportioning process or combustion rate to load demands—topic of 12-p brochure. Cleveland Controls, Inc

303 **Instrumentation** for water-treatment plants is topic of reprint. Topics such as effluent control, conductivity, sodium-zeolite systems are discussed. Graver Water Conditioning Company

304 **Pipeline flow control** through application of adjustable-speed units to pipeline pumping stations is topic of 8-p bulletin A-519. American-Standard Industrial Div

Liquid meters are topic of 20-p bulletin 43. Size, capacity, price, tables aid selection. Buffalo Meter Company

Begins on page 210

306 **Light-sensing level-indicating** system for controlling levels of opaque and solid materials is described in 4-p bulletin E-200. The Euclid Electric & Manufacturing Company

307 **Automatic control systems** for hot water, steam, gas-fired and electric unit ventilators are featured in application manual. Complete cycles of operation, damper-sequence charts, specs for precise temperature control and installation included for each unit. Barber-Colman Company

308 **Control catalog** lists complete line of hermetically sealed mercury switches, transformer relays—56 pp. Gives description, specs, engineering data for each control. Mercoid Corporation

309 **Pneumatic controller** for pressures to 170 psig is described in 2-p product spec sheet P41-2. Bailey Meter Company

310 **Explosionproof controls,** indicating, nonindicating and recording types, are discussed in 4-p booklet. The Partlow Corporation

311 **Snap-acting,** disk type thermal element actuates thermostats, circuit breakers and motor protectors—detailed in 29-p booklet. Non-disk-actuated controls included. Texas Instruments, Inc, Metals & Controls Div

312 **Recording annunciator** for process temperature, flow, pressure and level is topic of 4-p bulletin 102A. Panellit, Inc, Panalarm Div

313 **Recording instruments** are topic of 12-p bulletin GEA-6933. Provides buying info on firm's complete line. Dimensions, chart speeds, applications and specs included. General Electric Co

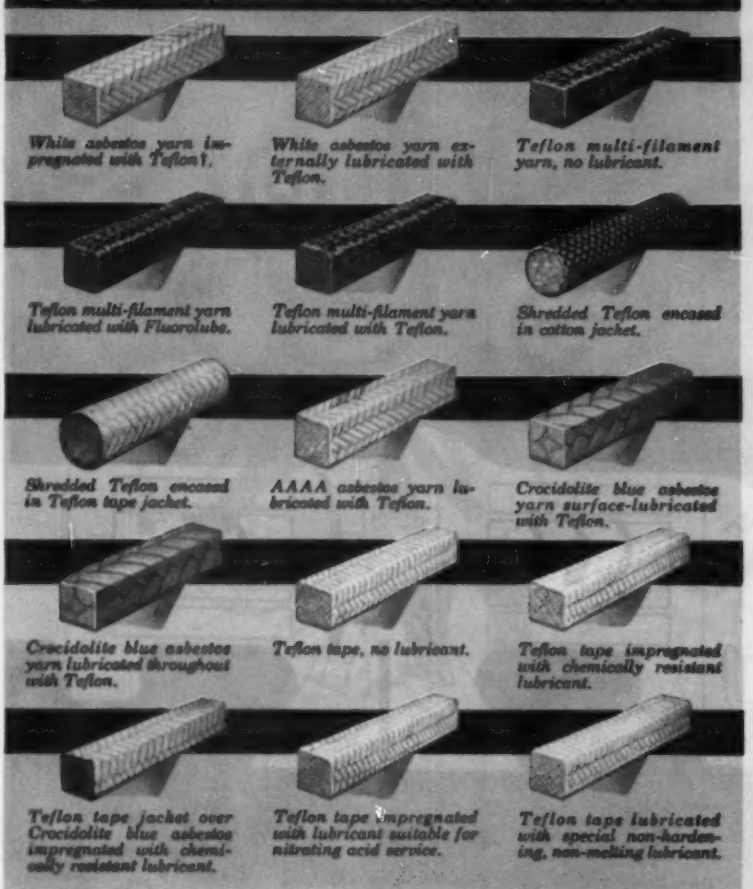
314 **Recording and testing** instruments are described in new condensed catalog G-10. Details firm's complete line. Minneapolis-Honeywell Regulator Co

315 **Temperature and pressure** recorders are announced in 8-p catalog 800. Spiral-bourdon-tube and bellows type pressure elements are pictured with materials and performance characteristics listed. American Machine and Metals, Inc, U.S. Gauge Div

316 **Multipoint recorder** permits you to change from 2 to 24 points in seconds. Details are in specification sheet 153-23. Minneapolis-Honeywell Regulator Co

317 **Multirange speed recorder,** expanded-scale type, is discussed

15 SPECIFIC PACKINGS FOR ALL CORROSIVE SERVICES


White asbestos yarn impregnated with Teflon†.
White asbestos yarn externally lubricated with Teflon.
Teflon multi-filament yarn, no lubricant.
Teflon multi-filament yarn lubricated with Fluorolube.
Teflon multi-filament yarn lubricated with Teflon.
Shredded Teflon encased in cotton jacket.
Shredded Teflon encased in Teflon tape jacket.
AAAA asbestos yarn lubricated with Teflon.
Crocidolite blue asbestos yarn surface-lubricated with Teflon.
Crocidolite blue asbestos yarn lubricated throughout with Teflon.
Teflon tape, no lubricant.
Teflon tape impregnated with chemically resistant lubricant.
Teflon tape jacket over Crocidolite blue asbestos impregnated with chemically resistant lubricant.
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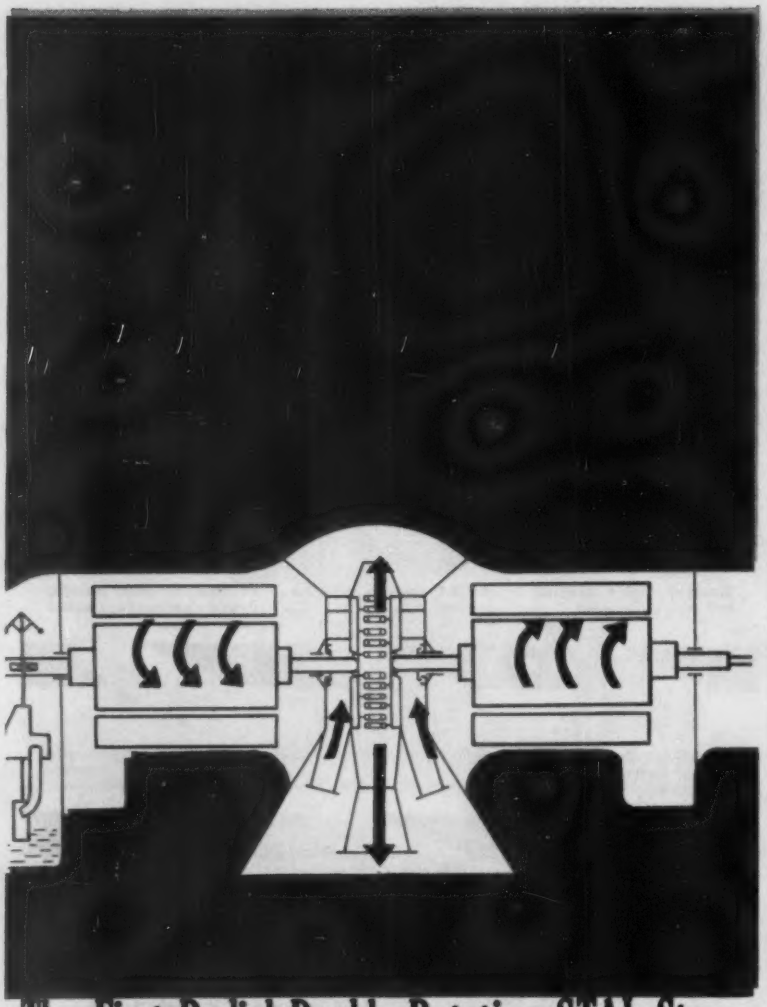

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Specifications

Make	STAL
Type	Radial flow double rotation
Throttle Steam Conditions	870 psig, 700F
Maximum Throttle Flow	500,000 lbs/hr.
Heaviest Life During Erection	21.5 tons
Turbine Heat Rate	3506 Btu/kwhr
2-3600 rpm Generators	Air Cooled
Power Factor	0.85
Back Pressure	150 psig
Rating	23,600 kva (combined)

Instrumentation

according to application, features, principles of operation and specs in 4-p bulletin GET-2741-3A. General Electric Company

318 **Industrial-temperature** measurement and control guide is 23-p booklet compiled to eliminate guesswork in temperature indication. The Partlow Corporation

319 **Multijunction thermocouple** terminal boxes—in 4-p bulletin 28. Thermo Electric Company

320 **Spring-loaded thermocouple** adapter is detailed in spec sheet 2A. Thermo Electric Company

321 **Metallic-sheathed thermocouples** and extension wire, oxide insulated, are announced in 4-p catalog 101. Specs, prices included. Research Instruments, Inc

322 **Thermocouple components** are described in specification PS005-3. Minneapolis-Honeywell Regulator Co

323 **Thermocouples,** components and accessories are featured in newly-revised 52-p catalog EN-82 which details firm's complete line. Leeds & Northrup Company

324 **Thermocouple well** 16-p catalog GL02-1 provides selection info. Minneapolis-Honeywell Regulator Co, Industrial Div

325 **Small-diameter** thermocouples, mineral-insulated type, are topic of brochure G 100-4. Specs and ordering info are included. Minneapolis-Honeywell Regulator Co

326 **Metal-sheathed** ceramic-insulated thermocouples are explained with typical applications in folder P1281A. The Bristol Company

327 **Thermocouples and assemblies,** stainless-steel-forged thermowells are covered in bulletins TT-307, TT-306. Temperature ranges, performance specs are given. Trinity Equipment Corp

328 **Multipointer gage units** for pressure and level measurements and pneumatic transmitting, receiving are described in 4-p brochure M42-2. Bailey Meter Company

329 **Vacuum gages** are detailed in catalog 175. Units are heated thermopile type. Hastings-Raydist, Inc

330 **Ultrasonic thickness testers,** lightweight portable models, are detailed in 8-p bulletin A-200. Branson Instruments, Inc

331 **Differential-pressure indicator** is introduced in data sheet. Hastings-Raydist, Inc

332 **Subminiature indicator,** showing elapsed-time operation, is de-

Begins on page 210

scribed in product specification sheet 5001. Waltham Precision Instrument Company

333 **Liquid meters** are topic of 20-p bulletin 43. Size, capacity, price tables aid selection. Buffalo Meter Company

334 **Thermometers** for outside use on pipelines or tanks are featured in 4-p bulletin F2. Precision Thermometer & Instrument Co

335 **Condensate-flow regulator** is detailed in data sheet. Stickle Steam Specialties Company

336 **Sample-testing meters** are informally discussed in 20-p booklet GED-3613. Acceptable accuracies and economic feasibility of meter testing are covered. General Electric Company

337 **Glass-tube purge meters** are described in new bulletin TP-1-RM. Range is from 0.01 to 30.0 gph water or 0.12 to 125.0 cfh air. Wallace & Tiernan, Inc

338 **Thermistor thermometers,** telethermometers covering a range from −50 to 300 F are topic of catalog sheets. Yellow Springs Instrument Company

339 **Electric tachometers** are featured in 4-p bulletin. The Electro-Mechano Company

340 **Tinned-steel-case** meters with capacities from 150 to 6000 cfh are described in bulletin 313. American Meter Company

341 **Miniature gages,** vertical type wth 5-in. scales for measuring differential pressure, temperature and pneumatic signals are described in 12-p bulletin 59-1. Republic Flow Meters Company

342 **Pressure gages** for oil, water, steam, gas are covered in folder DH-333. American Chain & Cable Co, Inc, Helicoid Gage Div

343 **Remote-reading** electrical flowmeters for all types of liquids and gases at line pressures to 5000 psi are featured in 28-p publication 59-5. Republic Flow Meters Company

344 **Accelerometers** are featured in new bulletin. Application info, mounting techniques and calibration methods are included. Endevco Corp

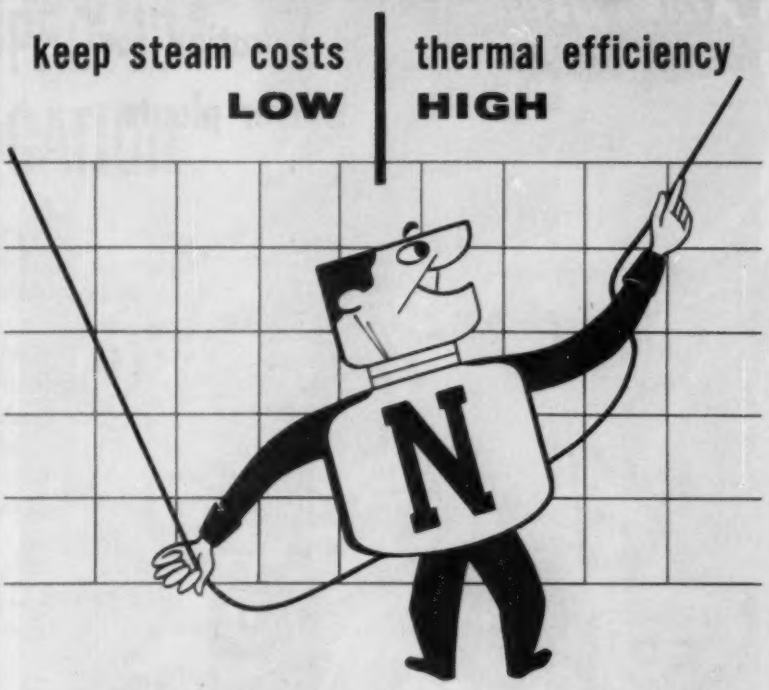
345 **Portable** temperature potentiometers with single and double ranges are described in 2-p data sheet ND42-33(1A). Leeds & Northrup Company

346 **Gaussmeter** is introduced in 2-p spec sheet. Operating principle, features, applications are given. F W Bell Inc

continued

Nicholson Thermostatic Steam Traps

keep steam costs LOW | **thermal efficiency HIGH**



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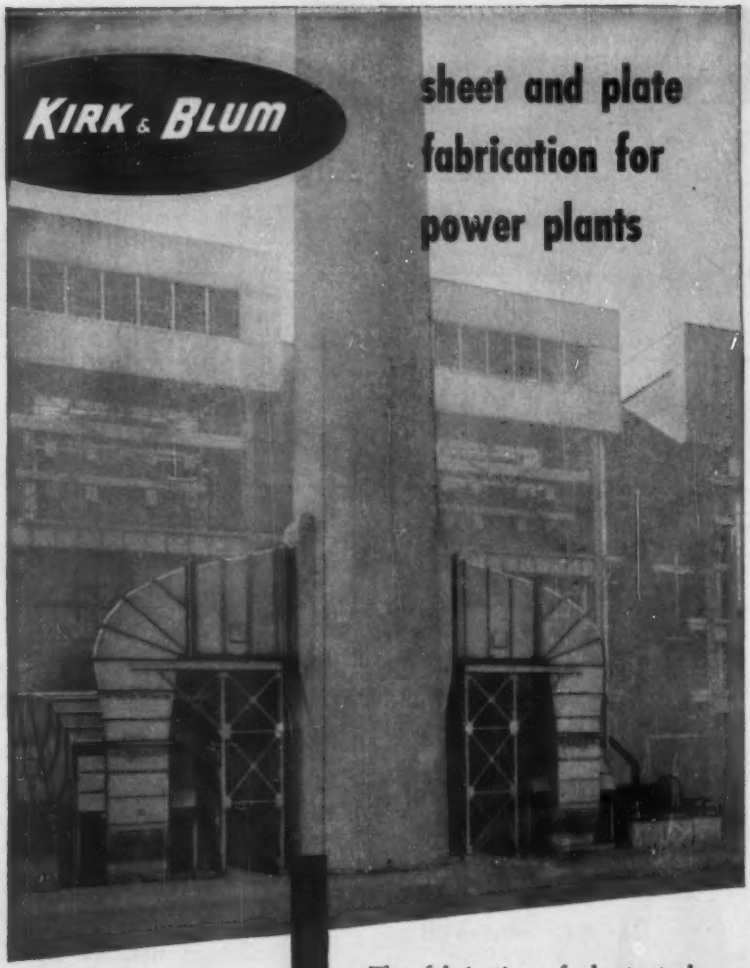

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Instrumentation

Begins on page 210

347 **Pyrometer** for precision temperature measurements is topic of catalog 175. Power Instrument & Control Supply Corporation

348 **Rotameter selector aid** 110 shows firm's full line of units. Brooks Rotameter Company

349 **Rotameter** for purge service is topic of spec sheet DS-130-1. Brooks Rotameter Company

350 **Rotameters** for corrosive applications are topic of 8-p bulletin 150. Describes, illustrates various meter designs. Brooks Rotameter Co

351 **Portable indicating pyrometer** for temperatures between -40 and 200 F is featured in handy 4-p brochure 2146-C. Illinois Testing Laboratories, Inc

352 **Precision frequency meters** with ranges between 10 and 1700 cps are described in bulletin 32. James G Biddle Company

353 **Lab and testing instruments** are covered in 14-p folder E 6. Potentiometers, galvanometers, ac and dc null detectors are some of the instruments described. Leeds & Northrup Co

354 **Instrument budgets** are discussed in case history. Shows how you can save money by using centralized source of electronic-test-instrument info. Technical Information Corp

355 **Installation** - through - startup service for automation and instrumentation systems is described in 16-p brochure 107. Panellit Service Corp

356 **Facilities** of firm's recently established instrument div are detailed in 4-p bulletin FB-1R. Federal Pacific Electric Company

357 **Instruments** for industry are covered in well-illustrated bulletin 19-60. All of firm's major lines are described. James J Biddle Company

358 **Analog-computer-control** systems, solid-state type, are featured in new brochure MSP-163. Application and installation info given. Hagan Chemicals & Controls, Inc

359 **Special-purpose** and general analog computers and accessories are described in 4-p brochure. Computer Systems, Inc

360 **Electric data system** for logging, monitoring, computing and optimizing control is described in 12-p booklet. Hagan Chemicals & Controls, Inc

361 **Analysis services,** laboratory facilities are described in well-illustrated booklet. Spectograph,

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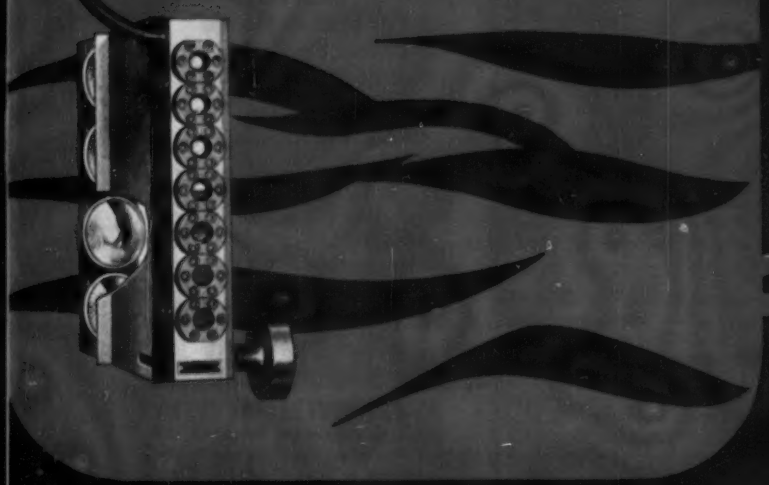

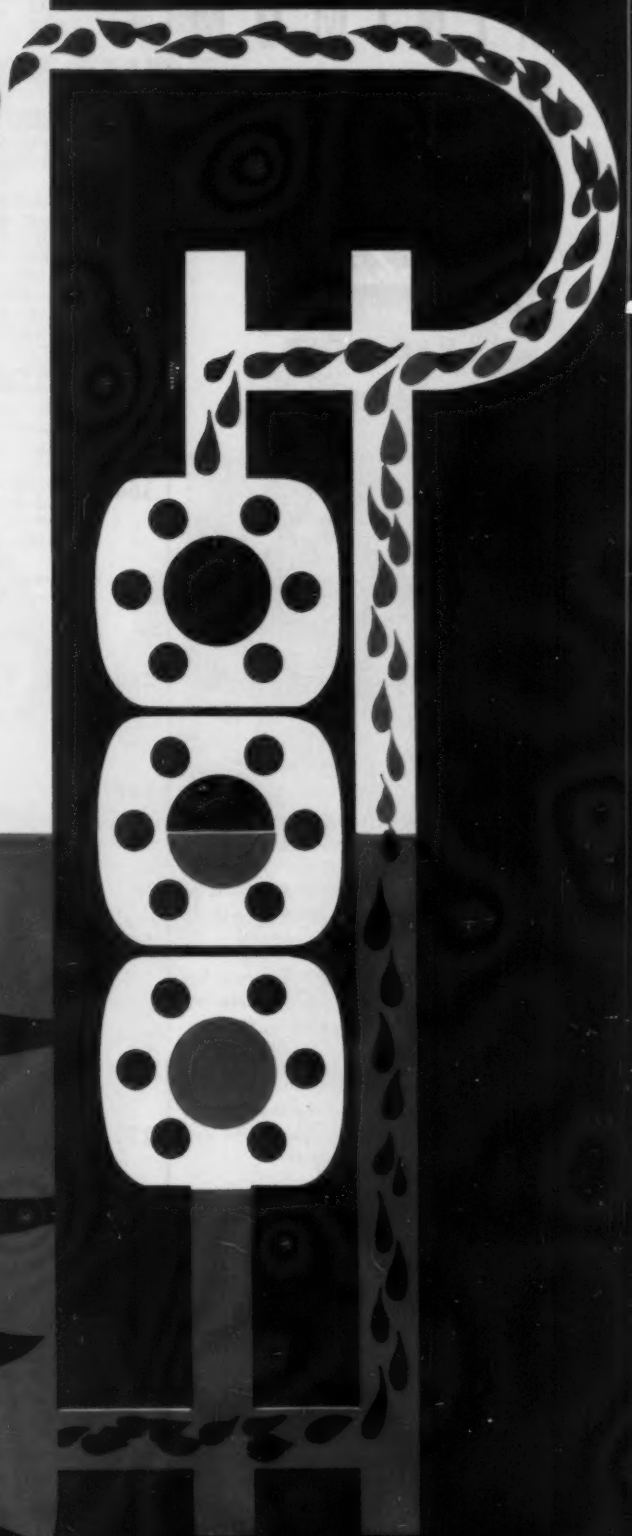

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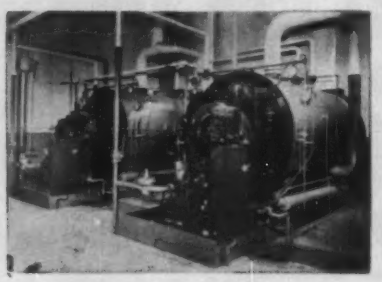

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Instrumentation

Begins on page 210

autrometer, quantometer are some instruments covered. Spectrochemical Laboratories, Inc

362 **Instrumentation** for industrial wastes is discussed in 26-p compilation of reprints. Features case histories of how instruments are applied to waste-treatment systems to prevent stream pollution. Minneapolis-Honeywell Regulator Company

363 **Control panels** for process-equipment control, remote control of systems handling and processing dry solids are featured in 12-p bulletin G-9. Fuller Company

364 **Test equipment** and panel instruments for industrial applications are described in booklet 28. Precision Apparatus Company, Inc

365 **Diaphragm seals** protect pressure instruments from corrosion and clogging—topic of bulletin 250. Brooks Rotameter Company

366 **Instructions** for using firm's temperature-sensitive crayons with calibrated melting points, Tempilstiks, are given in data sheet. Tempil Corporation

367 **Rotameters and flow indicators** are featured in condensed bulletin M-1. Instruments for measuring, indicating, recording and controlling are pictured and described. Schutte & Koerting Company, Instrument Div

368 **High-capacity flowmeter** with integral bypass design is detailed in spec sheet D8-132. Brooks Rotameter Company

369 **Fluid meters,** operation, ranges and installation requirements are included in 8-p bulletin 20. Bailey Meter Company

370 **Automatic flow controls** for low pressure drop are featured in folder 2305-7. Hays Mfg Company, Automatic Controls Div

371 **Electric process-control** system is described in data sheets—transmitters, transducers, receivers, controllers and final control elements. Minneapolis-Honeywell Regulator Company

372 **Instrument valve manifold** is topic of 2-p spec sheet. Diagrams show installation. Yarnall-Waring Company

373 **Miniature** secondary liquid-level indicator is transistorized—2-p sheet gives details. Yarnall-Waring Company

374 **Differential-pressure** transmitter is described, illustrated in 2-p bulletin. Advantages, specifications are listed, operation described. Yarnall-Waring Company

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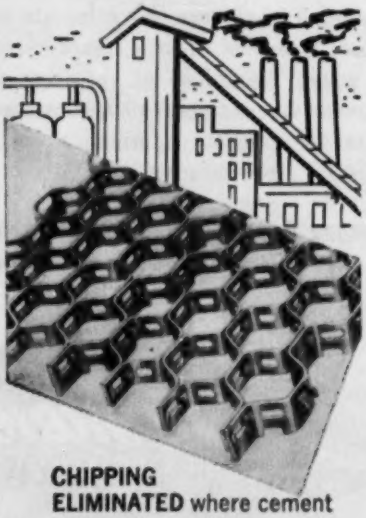

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Fig. 11303—Steel pressure seal O.S. & Y. gate valve for 1500 pounds. 600, 900, 2500 pound valves can be furnished.

Fig. 6061WE—Steel Swing Check Valve for 600 lb. pressure. Bolted Flange Cap. Also available for pressures from 150 to 2500 pounds.

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...the most unusual curtain wall

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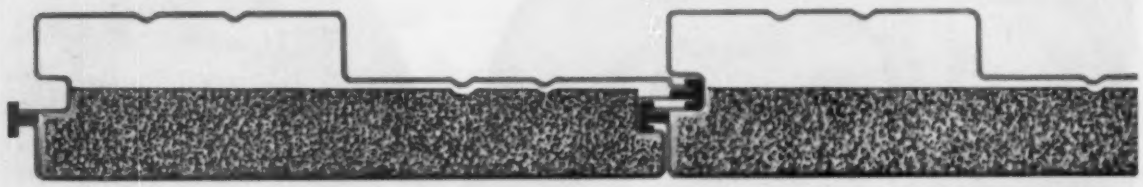
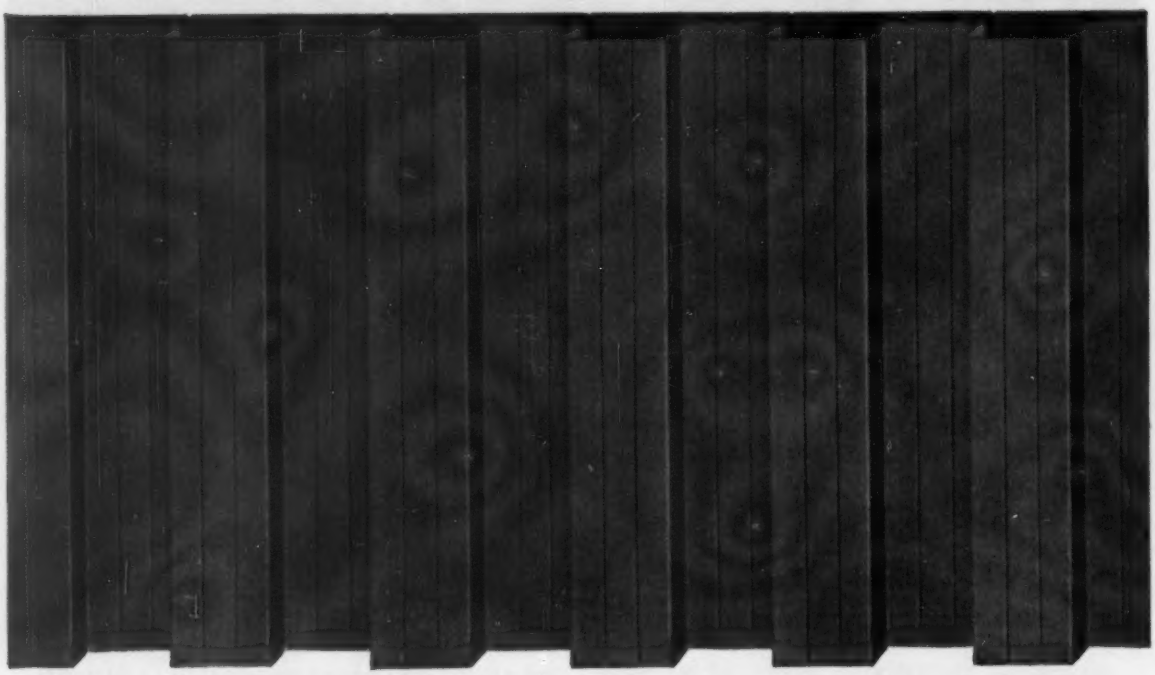
A factory-assembled wall panel in one foot modules . . . one that is self-sealing for life by mere installation. You never caulk it. And there are no visible outside joints or fasteners to mar the surface. This is Butler Monopanl, the most unusual curtain wall. Tongue-and-groove joints with double vinyl gaskets provide the seal. The cross section sketch tells the story.

Spanning ability is exceptional, as you can see from the configuration. Glass fiber insulation will not settle.

Beautiful Monopanl is furnished in a range of gauges. Exterior and interior faces can be specified in aluminum or galvanized steel. Choose from a selection of factory-applied colors. Integral fenestration is available.

For further information refer to Sweet's 1960 Architectural File. For complete technical details and actual samples of Monopanl, contact your Butler Builder He's listed in the Yellow Pages under "Buildings" or "Steel Buildings." Or write direct for a descriptive brochure and data sheets.





CELEBRATING 60 YEARS BUTLER FABRICATING METALS

"See Sweet's Industrial Construction File—Section 8-B"

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BUTLER MANUFACTURING COMPANY

7530 East 13th Street, Kansas City 26, Missouri

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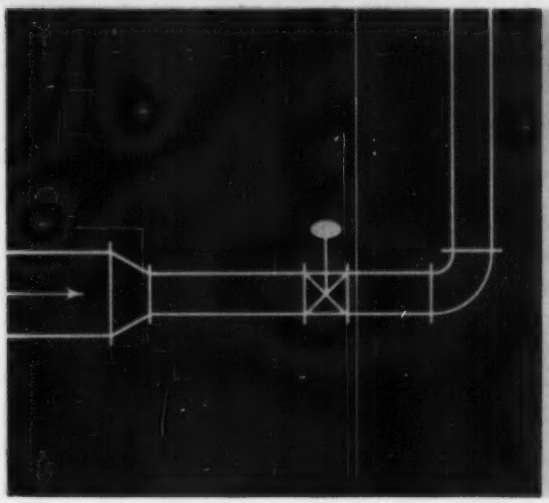
For more facts circle 878 on Reader Service card, p 207

For details circle key numbers, page 207



Plastic-pipe materials first developed for special uses continue to take over many less severe applications because of lower first cost, easy installation and low maintenance. This has led to increased availability of valves and specialties in a wide variety of plastics. And connectors for metal-to-plastic piping ease special problems in material transition.

Advancing valve technology follows several paths. Efforts to further reduce hydraulic losses cut plant operating costs. Increased automation has led to wholly new control-valve operating concepts. Valve-materials gains still keep pace with piping.

V. W. Edwards

Assistant Editor

Valves, piping, fittings and specialties

30 **Electropneumatic positioner** combines advantages of electronic controllers with power and throttling action of pneumatic control valves. A true positioner, device directly compares valve-stem position with controller output signal. For fast stoking speed it uses air relay; large magnetic-force motor supplies high-force changes. Simply installed and requiring little maintenance, unit is for 3-to-15- or 6-to-30-psi valve-spring ranges or for split ranging. You can adjust stroke through a plate-covered aperture without exposing wires, install valve in any position without calibration shift.—Worthington Corp, Maison-Neilan Div

31 **Versatile valve** combines three design elements—union bonnet, reinforced body and cylindrical body neck section. Characteristics and built-in safety features make it suitable for all applications in the 125- to 150-psi steam-pressure range. Long pipe threads in valve body permit tight valve-to-pipe jointing without risk of crowding pipe or distorting valve disks. Unit has deep stuffing box, hexagon head gland and back seats located above stem threads for efficient performance —available with rising or nonrising stems, single- and double-wedge disks.—Lunkenheimer Co

32 **Silent valve** cuts aeration, cavitation, surging and resultant noise. Flow passages are axially aligned holes in a cylindrical plug of elastomer. When plug is compressed, flow passages reduce in diameter, throttling fluid flow. At full compression, channels close for complete shutoff. When valve is wide open, fine gradations of throttling resistance assure precision flow, says maker. Fluid friction within large number of small-diameter flow passages dissipates energy of large pressure drops. Valve is available in line sizes from one in. to many ft, can handle a wide variety of fluids including water and petroleum products.—Aerojet-General Corporation

33 **Resilient-seated butterfly valve** gives positive drop-tight shutoff, is corrosion resistant, says maker. Much smaller in overall dimensions and weighing but a fraction of a gate valve, unit saves space, weight, cost. Streamlined disk opens full and returns to closed position in quarter of a revolution—no mating metal surfaces to corrode or bind. Abrasion-resistant rubber seat liner snaps into body and also forms gaskets for mating flange surfaces.—W S Rockwell Company

34 **Cartridge butterfly valve** is designed for quick and easy replacement. Cartridge unit consists of a standard butterfly valve in a wedge-shaped body which is inserted in the outer body and held in place with the cover. Flow characteristics are same as standard 2-flange valve.—Allis-Chalmers Manufacturing Company

Ball valves are designed to reduce initial in-place and valve-maintenance cost. They provide full flow, tight shutoff and quick quarter turn, feature 2-way flow, minimum pressure drop and self-adjusting seats. No lube. Valves are noncycling.—Hills-McCanna Co

36 **Single-seated control valves,** engineered to meet modern power-plant applications, feature high capacity, ability to handle high pressures and pressure drops and a wide selection of reduced-capacity trim. Minimum seat-ring areas result in less unbalance force, permitting higher pressure drops. — Worthington Corp, Mason-Neilan Div

37 **Gravity-metering drop-rate feeder** with head-loss equalizer is for air-conditioning cooling towers and corrosive chemicals. Head-loss equalizer screws directly into all standard chemical shipping drums and 2-in. threaded fittings. Range: one drop per min to ten gph, good for open-vessel as well as suction-side (vacuum) line feeding.—Sterling E Norcross Co

38 **Built-in-channel tube** should simplify and cut cost of recirculating heating fluids required in piping systems. The 1-piece extruded section has two integral channels flanking large pipe area. Heating medium

travels through one small passageway, maintaining temperature of material in large area to insure free flow. If necessary, fluid is reheated at terminal and then returns through second channel. Tube comes in 2-, 3-, and 4-in. sizes.—Aluminum Company of America

39 **Pipe-patching method** repairs small leaks in any fluid or gas line. Place patch directly over the leak, apply pressure with a tool. Two types of "hold-down" clamps are available—saddle type for ¾- through 6-in. pipe and chain type for 7- through 36-in. pipe.—M J Crose Manufacturing Co, Inc

40 **Pipe-suspension system** is geared to piping needs of heating - plumbing - air - conditioning systems. Metal framing line consists of preformed channel for structure of racks, framing fittings to connect channel pieces into desired framework. Pipe hangers support the system.—Fee & Mason Manufacturing Company

41 **Plastic-tubing insert** helps prevent rupture of polyvinyl-chloride, polyethylene and nylon soft-plastic tubing when used with brass or steel fitting connections. Tubing insert comes in ¼-, ¾- and 1-in. sizes.—The Weatherhead Company

42 **Teflon-lined hose** has low permeability, zero weather absorption. It withstands most chemicals except fluorine gas, chlorine trifluoride and molten-alkali metals. It's said to be both flexible and easy to handle, ending separation and splitting. Cleaning and sterilization are easy since nothing sticks to waxy lining. Hose is especially suitable for flexible constructions in process equipment handling corrosives, caking slurries or solvents. You can use it at temperatures to 325 F and working pressures to 1500 psi.—Raybestos-Manhattan, Inc, Manhattan Rubber Div

43 **Pipe element** features simple clamp closure, permitting removal of body tube for cleaning element while pipelines stay uncontaminated. Porous metal element can be used with or without filter aid. It comes as cylinder, bayonet, star or corrugated sintered woven-wire mesh. Filter withstands up to 10,000 psi. Several pipe sizes are available.—Pall Corp, Micro Metallic Div

44 **Flow-actuated electrical switch** can start and stop pumps, valves, alarms, signals or controls. It meets safety requirements for protecting expensive equipment against hazards of undesirable increase, decrease, reversing or loss of flow. Made of brass, bronze, steel or stainless steel, switch fits lines from ¼ to 60 in. Construction is leakproof—no packing glands or stuffing boxes.—Power Equipment and Engineering Company, Inc

45 **Continuous backup rings** for O-ring groove installations are low in cost, quickly and easily installed. Rings have concave shape to prevent extrusion and increase lubrication of O-ring. The 1-piece rings won't cut O-rings. They stand temperatures from −85 to 350 F, resist most fluids, gases, air.—Parker Seal Co

46 **Double-seal asbestos gasket tape** eliminates two separate gasket applications on sides of bolts or studs. Tape is wire with inserted open lattice, woven flat to desired dimensions, or plain woven nonmetallic asbestos. Latticework or bolt-space openings make it unnecessary to perforate tape beforehand. Openings and over-all thickness vary in size, and tape is plain or graphite coated.—Union Asbestos & Rubber Co, Fibrous Products Div

47 **Pressure-sensitive packing rings** combine asbestos with self-lubricating and heat-resistant Anklon for pneumatic and hydraulic service. Piston cup is made of same materials. Recommended for air, gases, chemical solvents and newer hydraulic fluids at temperatures to 500 F and higher.—Anchor Packing Co

48 **Nylon fitting** connects copper, plastic or aluminum tubing in an effortless two seconds, maker claims. You can make connections without clamps on plastic pipe and without having to flare, bell or solder metal tubing. Butyl O-ring seal partially embedded in fitting gives a positive seal. Simply insert fitting in tube with a twisting motion. Serrated spring-steel ring in front of O-ring seal bites into outer-tube surface, for strength when tube and fitting are placed in tension. Unit is available for ½- to 2-in. standard tubing, male or female threads. You can disassemble it for re-use.—D & G Plastics Company

49 **Brass fitting** for plastic tube never needs tightening, gives complete retention on polyethylene, nylon and other plastics. Insert-collet locking action of design is said to eliminate pulling out of fittings due to cold flow. Brass insert holds tube firmly and prevents collapsing. Fittings can also be used with copper, steel and aluminum tubing.—Commonwealth Brass Corporation

50 **Fiber-glass-reinforced epoxy fittings** offer good resistance in transferring wide range of corrosive liquids. Epoxy fittings and pipe operate to 350 F and 150 psi. They come in sizes from one through six in.—Ed Conley Plastic Corp

51 **Combination filter** handles air, hydraulic-fluid duties. Coarse-wire screen for large particles and cellulose sheet sandwich a specially developed nonwoven material for stopping large quantities of small particles in 3-stage full-flow filter. Two- to 10-gpm elements have filtered 20 grams of fine dust at pressure drop of 4 psi, 60 grams at 60 psi. Combination filter medium works as mist remover in air cooling and prefilter for hydraulic fluids.—Purolator Products, Inc

52 **Self-cleaning screen** is made up of wedge wire featuring thinner profiles. Wedge-shaped profile is reported to cut clogging—particle that passes top easily clears entire opening. High, narrow profiles squeeze more wires per area of working screen surface, increasing percentage of open area, screening and dewatering capacity. Slit widths run down to 0.002 in. Developed in Germany, screen is sold in U.S. by—National-Standard Company, Cross Perforated Metals Plant

continued

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Lightweight Aluminum Alloy Frames . . . Fold-in Reamers
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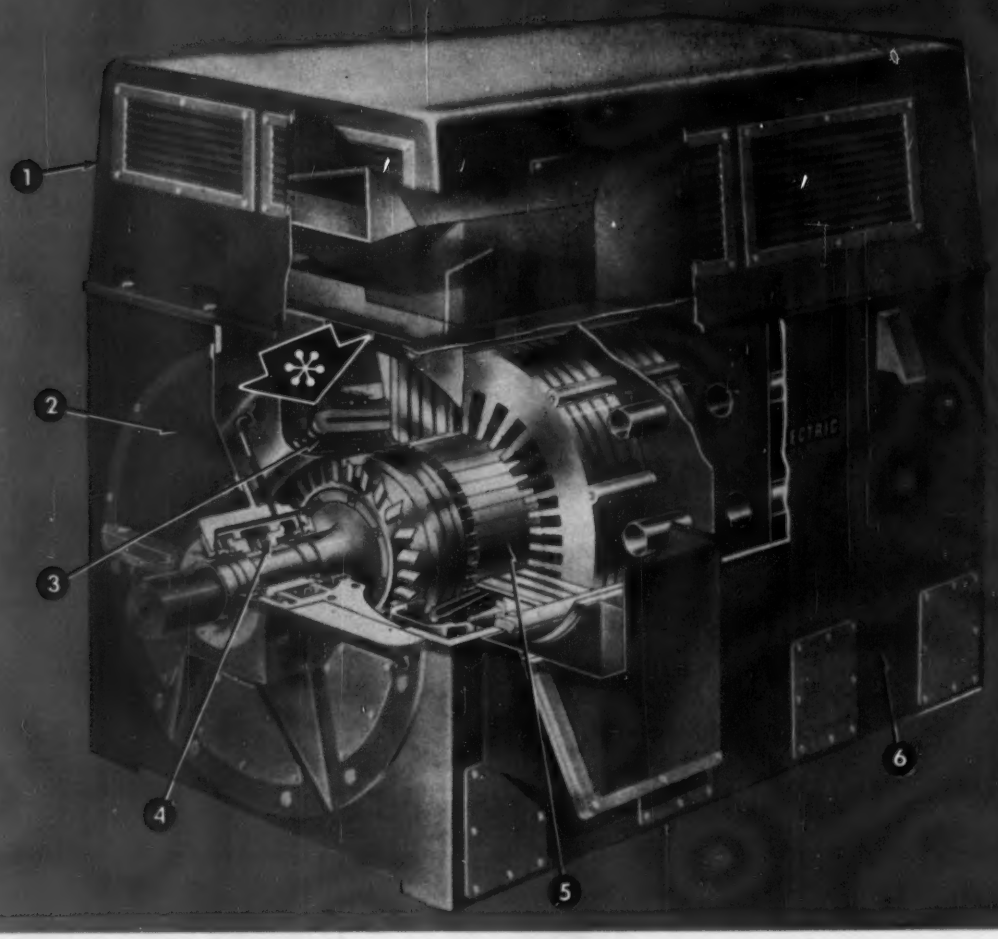
RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

For more facts circle 879 on Reader Service card, p 207

NEW General Electric CUSTOM '8000' Boiler Feed Pump Motors . . .

CUSTOM DESIGNED FOR POWER STATION APPLICATIONS



1 REMOVABLE "TOP-HAT" provides easy access to motor interior. Top-hat is baffled and lined with sound absorbing materials to attenuate motor operating noise. Rotor and stator are constructed to reduce noise and direct sound waves into the acoustically treated top hat.

2 NEW END SHIELD DESIGN reduces time required for inspection and maintenance. One man can quickly unbolt and lift off the upper end shield half and remove the split air deflector. Bearing support is integrally cast with the lower end shield. Lower half of bearing can be "rolled out" for inspection without removing end shield.

3 EXCLUSIVE POLYSEAL* SUPPORTED SILICONE RUBBER INSULATION SYSTEM provides superior mechanical, thermal, voltage and environmental endurance—affords top reliability in critical Electric Utility applications.

4 TRIPLE PROTECTED BEARING SYSTEM lengthens boiler feed pump motor life. A primary seal is formed by the ring mounted on each end of the bearing shell and adjacent oil slinger machined in the shaft. A multiple groove seal at each end of bearing housing acts as a second line of defense against dirt entrance and oil leakage. In addition to the slingers and close running labyrinth seals, G.E.'s new bearing system utilizes an *Air-Lock* seal in each bearing housing. Air at slightly higher than atmospheric pressure is piped to annular grooves at each end of the bearing. This air pressure acts as a third seal to keep oil locked in the bearing housing.

5 ROTOR PARTS ARE MACHINED TO PRECISION TOLERANCES and assembled using especially developed techniques to assure high-speed operational stability.

6 RUGGED FRAME ASSURES SOLID STRUCTURAL SUPPORT for stator, end shields, rotor and top-hat. Frame is precision machined to positively align motor parts.

GENERAL ELECTRIC'S "CUSTOMIZED" MOTOR manufacturing philosophy permits the design flexibility, and the adherence to quality control production standards, which assure Electric Utilities of optimum motor performance, reduced operating costs and lower first cost. In keeping with requirements of Electric Utilities, Custom '8000' boiler feed pump motors are available now in ratings to 10,000-hp. 883-01

* Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

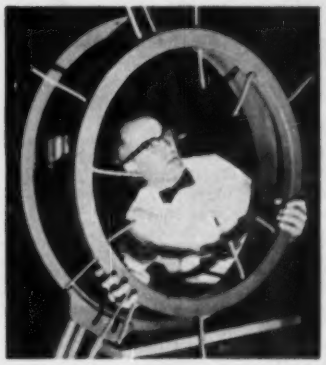
For more facts circle 880 on Reader Service card, p 207

NEW

encapsulated connection harness increases mechanical strength, assures maximum motor reliability

General Electric's new encapsulated connection harness consists of two rings of insulated conductors encapsulated in epoxy resins. The larger ring contains motor leads and phase connections, while the smaller ring contains equalizer connections.

This new system provides greater strength and rigidity at the end turns and assures uniform coil connections. Rigid encapsulation prevents contact between conductors—eliminates insulation abrasion. The epoxy compound provides additional insulation for leads and connections.



NEW ENCAPSULATED CONNECTION HARNESS for General Electric boiler feed pump motors provides an immobilized connection bundle . . . eliminates loose ties and abraided insulation.

YOUR GENERAL ELECTRIC APPARATUS SALES REPRESENTATIVE has full details on new G-E boiler feed pump motors. Call him today. Medium AC Motor & Generator Department, Schenectady 5, N.Y.

Progress Is Our Most Important Product

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• Valve, piping, fitting and specialty design aids:

Just circle key numbers on the Reader Service card, page 207, to get complete product story

375 **Pressure hose** and couplings of all-synthetic construction for hydraulic and other high-pressure applications are featured in catalog NEPR-500. Minimum burst pressure is 9000 to 12,000 psi depending on size. The Imperial Brass Mfg Company

376 **Complete line** of rubber hose for general industrial applications is subject of 24-p booklet. Describes over 35 types of hose with illustrations, sizes, weights, ply working pressures. Mercer Rubber Company

377 **Branch-connection fittings** are topic of new booklet. Applications, cost comparisons, engineering design data and benefits are discussed. H K Porter Company, Forge and Fittings Div

378 **Globe valves** are covered in spec sheets 70-18, 73-26. Valves are rated at 3000 and 6000 lb. Black, Sivals & Bryson, Inc

379 **Bronze and iron-body** gate, globe and check valves for heating, piping and a-c systems are featured in bulletin V-6. Cayton Inc

380 **Rubber-seated butterfly** valves for hydrostatic pressures up to 125 psi and velocities up to 16 ft per sec are featured in 36-p catalog. Darling Valve & Manufacturing Company

381 **Ductile iron pipe** and fittings are discussed in 20-p well-illustrated and comprehensive brochure. Properties, specs, corrosion-resistance data are given. James B Clow & Sons, Inc

382 **Tubing** capable of carrying internal pressures of 15,000 to 100,000 psi is topic of data sheet 22. Superior Tube Company

383 **Plastic pipe** is discussed in 16-p bulletin CE-80. Table of sizes, weights and pressures, technical data and info on plastic fittings and valves are included. Amerace Corporation, American Hard Rubber Co Div

384 **Solenoid-valve** stock list and selection guide is a 16-p booklet with illustrations and flow diagrams. Automatic Switch Co

385 **Magnetic solenoid valves,** electrically controlled, are described in catalog of firm's complete line. Magnetrol Valve Company

386 **Motorized valves,** electric motor operators are described with valve features, specs in 24-p cat-

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Jerguson Heated Gages and Valves are built to meet the special conditions present when working with liquids which must be kept at higher than ambient temperatures . . . for process reasons or to hasten the speed of response to level changes. They also have wide application to prevent breakage through freezing.

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assures effectiveness of its protective boiler flame controls with . . .

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At Douglas Aircraft in Tulsa, Micro Power serves as the dependable rear guard to the boiler room. It provides a constant source of steady, independent electrical power as required by the safety controls, thereby eliminating voltage fluctuations and protecting against power failure.

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For complete information on this and other Micro Power applications, write . . .

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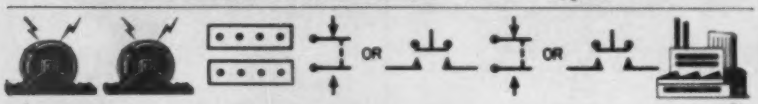
For more facts circle 882 on Reader Service card, p 207



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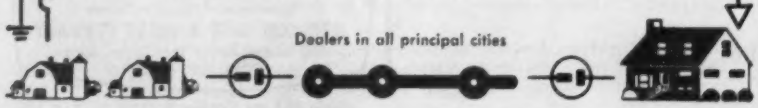


For more facts circle 883 on Reader Service card, p 207

Valves, piping

Begins on page 225

alog 407. Dimensions, weights, data are given for each model. Schade Valve Mfg Company

387 **Flexible hose** for steam transmission is covered in 4-p booklet. Titeflex Inc

388 **Mechanical-packings** catalog has 64 pp of comprehensive information on firm's complete line. Wide selection of cross-section photos, simplified packing chart aid selection. Johns-Manville Co

389 **Swing joints** in bronze, steel, monel and aluminum are subject of 12-p bulletin F-8. Specifications given. OPW-Jordan

390 **Expansion joints** are discussed in 6-p bulletin—info given on nomenclature and selection. Badger Manufacturing Company

391 **Rubber expansion joints** and flexible pipe are covered in catalog 850. General Rubber Corp

392 **Seals regulate valves,** pressure switches, remote positioners, balanced valves, etc—topics of loose-leaf manual. Applications, standard - tolerances tables, installation techniques given. Bellofram Corp

393 **Molded cups** for pump pistons, hydraulic service and pneumatic equipment are featured in new bulletin AD-145. The Garlock Packing Company

394 **Metal O-ring** design manual is 8-p folder of descriptions and illustrations of firm's line. Four spec sheets are included. The Advanced Products Co

395 **Corrosive-duty shaft seal** made of Teflon is described in new-product bulletin. Size range: ⅝ to 2 in. Crane Packing Co

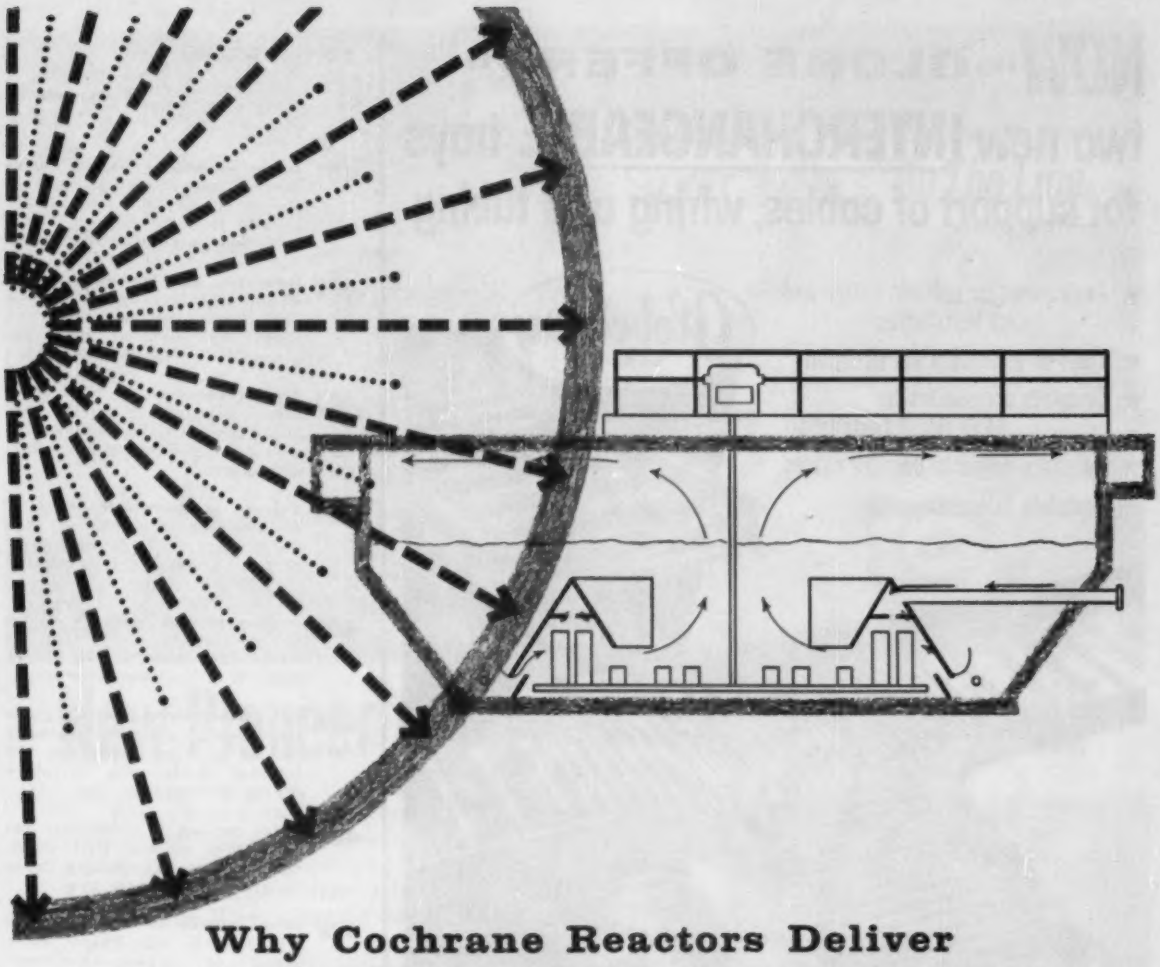
396 **Seals,** their engineering and applications are described in 8-p AD-150. The Garlock Packing Company

397 **Control valves** with venturi-ball design are described in 16-p catalog GV-101. Valves will handle pressures to 50,000 psi, temperatures from −425 to +1800 F. General Kinetics Corp

398 **Pressure-reducing valves** with range from 250 psi at 450 F in cast iron to 900 psi at 750 F in steel are described in 4-p folder. Atlas Valve Company

399 **Buyers' guide** includes valve comparisons of 16 major manufacturers and valve-trim chart. The Ohio Injector Company

400 **Butterfly-valve designs** for 9000 applications are covered in 4-p condensed bulletin 50-1. Fisher Governor Company, Continental Equipment Co Div



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189

PRODUCTS DIVISION

The **GLOBE** *Company* MANUFACTURERS SINCE 1914

4036 SOUTH PRINCETON AVENUE, CHICAGO 9, ILLINOIS

Valves, piping

Begins on page 225

401 **Double-cushioned check valves** prevent hammer and shock, handle water, gas, oil, other fluids. Details in 4-p WS-1A. Golden Anderson Valve Specialty Co

402 **Iron-body gate valves** are topic of bulletin which lists firm's new line. Service ratings, sizes and dimensions, material specs are given. Walworth Company

403 **Temperature-control** and back-pressure regulator valves, both pilot-operated, are subjects of product sheets JNP-2, JNP-3. OPW-Jordan

404 **Valves for automatic relief** of overpressure in steam, air and gas systems to 250 psig are topic of publication 5200-A. Cochrane Corporation

405 **Resilient-seated** butterfly valves and corrosion-resistant valves are featured in bulletins 590X and 802D. W S Rockwell Company

406 **Corrosion-resistance-rating** guide for metals, plastics, synthetic rubbers used in valves lists 390 different fluids with corrosive effects. Hydromatics, Inc

407 **Valve catalog** is completely revised 16-p edition, lists specs, ratings. American Chain & Cable Co, Inc, R-P&C Valve Div

408 **Check valves** are presented in 20-p bulletin 600. Charts show effects of engineered-spring-closing valve. Specs on various models, 125 to 1500 psi, are given. Combination Pump Valve Co

409 **2-way valves** for air, oil, water, gas or chemicals with psi rating to 500 are topic of 8-p bulletin 91022. Airmatic Valve, Inc

410 **Rubber-seat butterfly valve** is subject of comprehensive catalog 10K. Price list, specs, selection info make it a working tool for engineers. Henry Pratt Company

411 **Firm's line of valves** is presented with ordering info in new booklet. Circle Seal Products Company, Inc

412 **Steel flexible-wedge** disk gate valves, 150 to 300 lb with psi range from 40 to 720, are detailed in folder. Crane Company

413 **General-purpose valves** for industry are covered in 40-p catalog 160. Flare fittings, drain cocks, brass pipe fittings also presented. Madden Brass Products Co

414 **Pressure-reducing** and regulating valves are detailed in spec sheet. A W Cash Valve Mfg Co

415 **210-nozzle** sliding-gate pressure regulators are featured in catalogs J160-1 and F-210 available from OPW-Jordan

For more facts circle 885 on Reader Service card, p 207

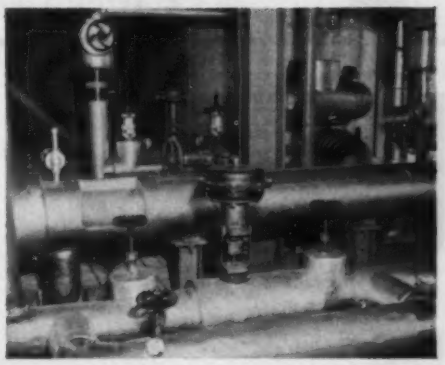
New Pioneer Along The "Old Oregon Trail"

Within sight of the "Old Oregon Trail" near the town of Glenrock, Wyoming, rises a new monument to Wyoming's modern era of industry and progress. It is Pacific Power & Light's new $23-million Dave Johnston steam-electric plant which boosted Wyoming's total electric power supply by one-third.

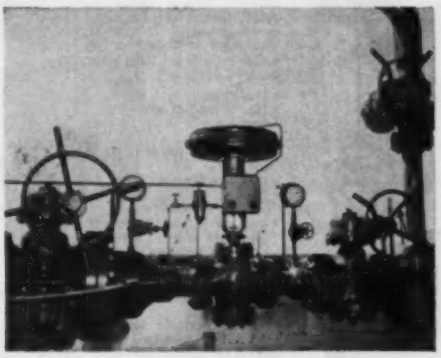
Engineered and constructed by Ebasco Services Incorporated, this ultra-modern plant utilizes BS&B Super 70 Diaphragm Control Valves, Pressure Controllers, Liquid Level Controllers and Transmitters for many vital roles in the plant's operation.

In the forthcoming No. 2 Unit of this plant, BS&B Controls will again render proud service to the Power Industry.

BS&B Controls are becoming renowned throughout the power industry for their superior performance characteristics and rugged dependability under widely varying operating conditions. Why not specify them for *your* next plant project? For detailed information, contact your nearby BS&B Controls Representative, or write directly to...



Evaporator Feedwater Level Control Valve



Plant gas supply is reduced from 400 to 150 psig by this Super 70 Pressure Reducing Valve and Controller.

BS&B — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Dept. 4-Q10 301 N. Cincinnati • Tulsa, Oklahoma

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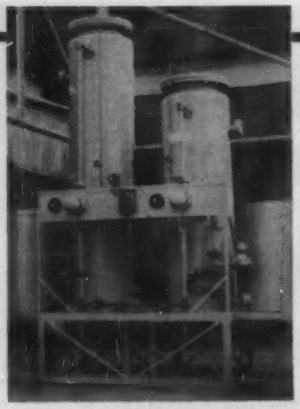

NEW FROM H&T

Low-Cost • High-Performance

"PACKAGE" DEMINERALIZERS!

TWO-BED and UN-A-BED STANDARD UNITS

NOW AVAILABLE!!

Unless *special* conditions require you to use a *special* demineralizing system, you can save big money—and get excellent results—with the new H&T Standard "PACKAGE" DEMINERALIZER! Into these superior Standard Units, we've put the experience of 16 years in building many hundreds of manual and automatic demineralizing systems. *Result:* H&T "PACKAGE" DEMINERALIZERS are masterpieces of design and construction—unequalled in performance and wonderfully low in cost.

Write for details of Two-Bed and Un-A-Bed Demineralizers

H&T SERVICE

HUNGERFORD & TERRY, INC.

CLAYTON 3, NEW JERSEY

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Babbitt

Adjustable SPROCKET RIM

with Chain Guide

Changes that Danger Zone to a SAFETY ZONE

When you modernize to make money, go all the way. Cut piping costs to minimum with planned simplification. Give your staff a free hand to effect economies—at the same time, convert Danger Zones to Safety Zones. Equip every overhead valve wheel in your plant with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. Just phone your mill supply salesman, or contact us.

Babbitt STEAM SPECIALTY CO.

2 Babbitt Square, New Bedford, Mass., U.S.A.

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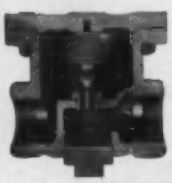
Sooner or later you too will be trapped by RIGGIO (why not now)

RIGGIO

THERMOSTATIC STEAM TRAPS

pressures from Vacuum to 250 lbs.
Semi-steel Construction
½", ¾", 1", 1¼", 1½", 2"



TYPE B-250

pressures from Vacuum to 200 lbs.
Bronze Construction
½", ¾", 1"

TYPE A-200
Freeze-Proof

Simple
Rugged
Versatile
Tight Shut-off

For additional information contact

FRANK D. RIGGIO CO., INC.

State Highway 17, Rutherford, New Jersey

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Valves, piping

416 **Standardization of alloy steels** for tubing applications is topic of folder TDC-193. Through-hardening and case-hardening are detailed. Babcock & Wilcox Co, Tubular Products Div

417 **Brass and steel tube fittings,** tube-working tools and hose are covered in 16-p condensed catalog C-201. The Weatherhead Co

418 **Packing - recommendation chart** simplifies selection. Raybestos-Manhattan, Inc

419 **Packings made of fabric,** foil, plastic or filament are detailed in 8-p bulletin. 14 types, nine constructions described and illustrated. Greene, Tweed & Company

420 **Polyvinyl-chloride** and polyethylene pipe, high-impact styrene-alloy sewer pipe are featured in three 4-p folders from Keasby & Mattison Company

421 **Small-tubing analyses** of columbium, tantalum and vanadium tubing are subjects of analysis memo 121. Superior Tube Co

422 **"Recommended piping practice"** is illustrated wall chart with sections on basic valve types, connections, installation, operation. Lunkenheimer Company

423 **Tilting-disk check valves,** 1-piece cast-steel type, are featured with ratings, flow-index table, curves, material specs in 12-p catalog 14-Y. Edward Valves, Inc

424 **Hydro valve line** is detailed with specs on sizes, capacities, materials in 4-p bulletin L-100/59. J E Lonergan Company

425 **Bronze-solder-joint valve** is topic of 4-p folder. Walworth Company

426 **Valve permits draining** water from bottom of storage tanks, won't freeze. Bulletin 500-2-1 tells the story. The Johnston & Jennings Company

427 **Relief valve for regulating** discharge pressure of oil or water is featured in bulletin. Atlas Valve Company

428 **Concentric** and flat-leaf vacuum filters for industrial process waters are topic of 4-p bulletin 1860.20-2. B-I-F Industries, Inc

429 **Tubing and pipe** of super-corrosion-resistant alloys are detailed in new bulletin, applications outlined. The Carpenter Steel Co

430 **How to cut costs** by using alloy mechanical tubing is topic of 4-p folder. Babcock & Wilcox Co, Tubular Products Div

Begins on page 225

431 **Pressure regulator** for reducing applications and differential-operated trip valve to isolate line breaks are described in bulletins 124, 170. American Meter Company

432 **Motorized valve operators** are topic of 20-p catalog. Philadelphia Gear Corp

433 **Piping-systems** fabrication and erection for power stations and industrial plants throughout the country are highlighted in 24-p publication 60B. Midwest Piping Company, Inc

434 **Engineering** plastic-piping systems for corrosive service is topic of 16-p handbook 1159. Includes chemical-resistance and physical-properties charts. Chemtrol

435 **Supports** for piping and equipment are covered in 96-p book. Well illustrated with photos, drawings and tables, book also gives details on constant-support hangers and many others. Bergen Pipesupport Corp

436 **Solving piping-flexibility** problems with ball joints is subject of 8-p bulletin 31-A. Photos, diagrams illustrate explanation. Barco Manufacturing Co

437 **Butterfly valves** for control of large volumes of liquids or gases are topic of 4-p folder. Worthington Corp, Mason-Neilan Div

Just circle key numbers on Reader Service card, p 207, to get complete story

Coming events

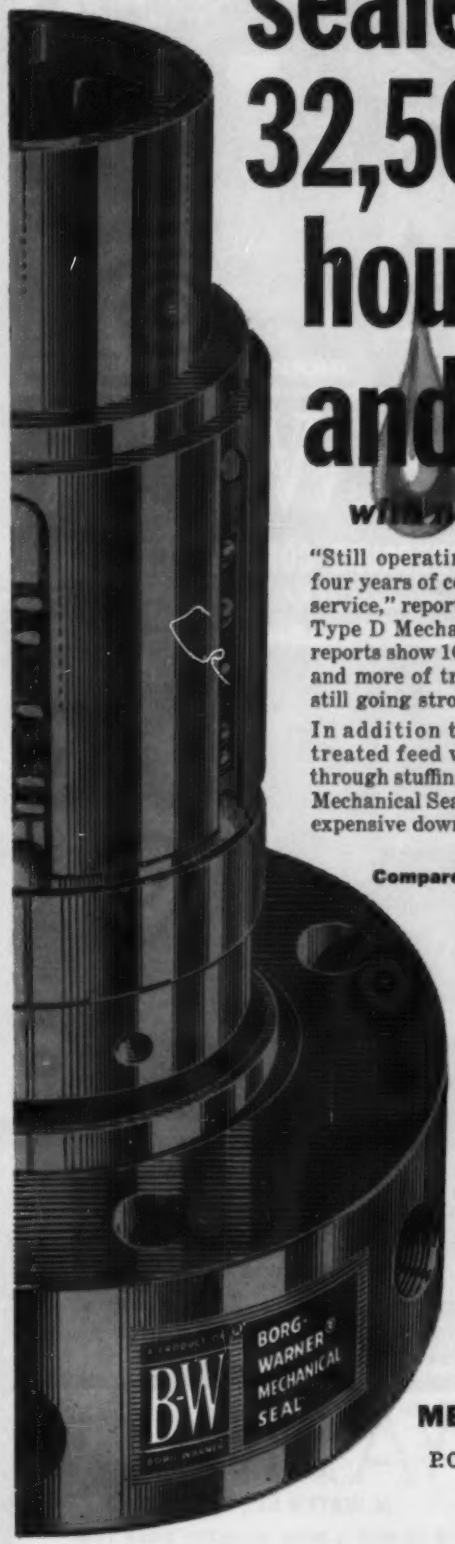
Oct 9-12—American Society of Mechanical Engineers, Rubber and Plastics Conference, Lawrence Hotel, Erie, Pa. Details: ASME, 29 W 39th St, New York 18, N. Y.

Oct 9-13 — Electrochemical Society, Inc, Meeting, Shamrock Hotel, Houston, Texas. Details: ECS, 1860 Broadway, New York 23, N. Y.

BOILER FEED PUMPS

sealed 32,500 hours and more

with no maintenance!



"Still operating perfectly after almost four years of continuous boiler feed pump service," reports one user of Borg-Warner Type D Mechanical Seals. Other typical reports show 10,000—25,000—30,000 hours and more of trouble-free operation...and still going strong!

In addition to important savings in treated feed water and heat often lost through stuffingbox leakage, Borg-Warner Mechanical Seals have proved they can cut expensive down time and maintenance.

Compare your seal performance...

If your present sealing method is not giving the long, reliable performance you think it should, we invite you to compare your record with actual user reports of B-W Type D Seals. Your nearest Borg-Warner Mechanical Seal sales engineer will be glad to show you the proof! Already sold? Then write or call for the new Type D Seal bulletin with complete engineering and installation data for equipping your present boiler feed pumps with modern Borg-Warner Mechanical Seals!

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MECHANICAL SEALS

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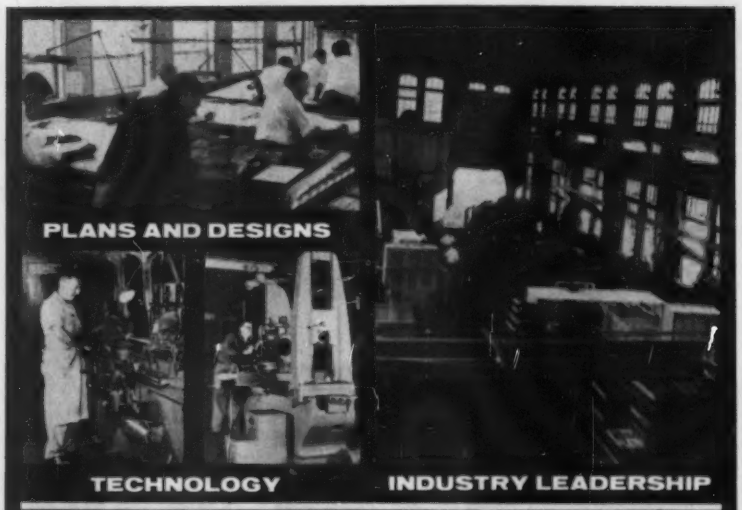

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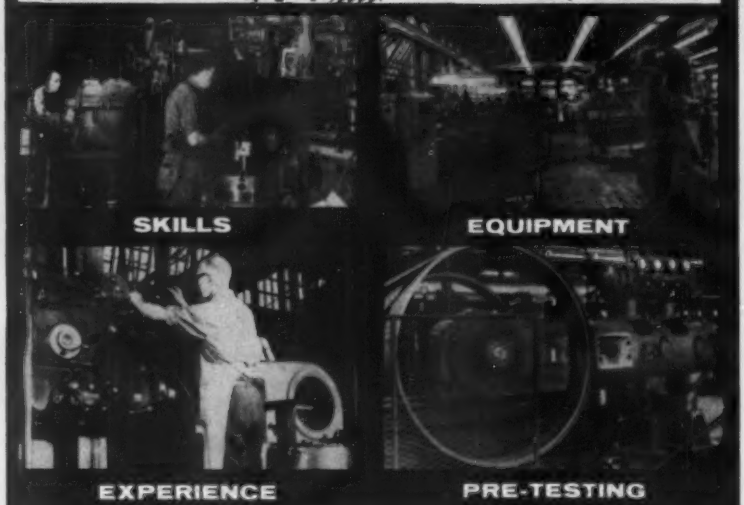
Manufacturers of HIGH PRESSURE COMPRESSORS AIR and GAS

For almost 100 Years



Complete, integrated facilities in engineering, production and testing create NORWALK COMPRESSORS — unexcelled in world-wide industry for quality, dependability and safety — that are individually designed, efficiently balanced and fully capable of rendering years of low cost service and a minimum of maintenance. Particularly produced for every industry . . . for every purpose: single stage to six stages, from 0 to 42,000 psi pressures, for a full range of gases and air.

Phone TEmple 8-4766 in South Norwalk
for prompt consultation and information.
Detailed, descriptive Catalog 1960 available on request.

NORWALK COMPANY, INC.
N. WATER ST., S. NORWALK, CONN.
COMPRESSOR SPECIALISTS TO WORLD-WIDE INDUSTRY SINCE 1864

● Prime movers:

Just circle key numbers on Reader Service card, p 207, for complete details

53 **Open-cycle single-shaft gas turbine** with NEMA rating of 9000 bhp is capable of continuous operation under full-load conditions at normal rated speed of 5000 rpm. Compact unit is designed for savings in equipment cost, transportation, floor space, foundation and installation expense—said to insure minimum speed variations under transient load conditions. At rated speed, axial compressor delivers a mass flow of 135 lb per sec. Turbine inlet is held under 1400 F for substantial margin of operating safety. Unit burns either liquid or gaseous fuels. — Clark Bros Company

54 **Ultra-lightweight gas turbines** with high power-to-weight ratios and compact size are designed for mobility. Line will range in output from 50 to 20,000 shaft hp, serve as prime movers in electrical-generating operations, drive power-supply systems for production of electricity in remote locations and handle auxiliary or emergency duty. Turboshaft engine with 20,000-hp rating can be applied to 7500-kva mobile power unit. Its compressor is 17-stage axial-flow single-rotor type. First six stator stages and inlet guide vanes are variable to provide rapid stall-free starting. The 3-stage turbine has wheels coupled to compressor rotor by conical shaft for low weight and high strength. Two men can carry basic engine which weighs only 300 lb.—General Electric Company

55 **Steam-turbine supervisory system** scans turbine-generator speed, valve position, shaft eccentricity, expansion, vibration, records data on two strip-chart recorders every five sec. Size reduction of panel area is from 18 sq ft to six. Decrease in number of components improves unit's reliability and ease of maintenance, says maker —vacuum tubes are cut from 22 to seven. Recorders are duplex ink-writing and multi-point type. —General Electric Company

56 **Diesel engine** with high-rising torque is designed to put more power into a job and keep equipment at right operating speed for efficient production. Total amount of power that goes into any job is determined by engine's reaction to load and speed changes. Torque characteristics of an engine govern these changes, so this engine's high-rising torque puts power into the job as needed, says maker. Unit takes hold of a load and keeps it going with a sort of lugging power to help keep equipment at right speed. Available from 105 to 320 hp in dual-fuel models capable of delivering mechanical and electrical power simultaneously. — Murphy Diesel Company

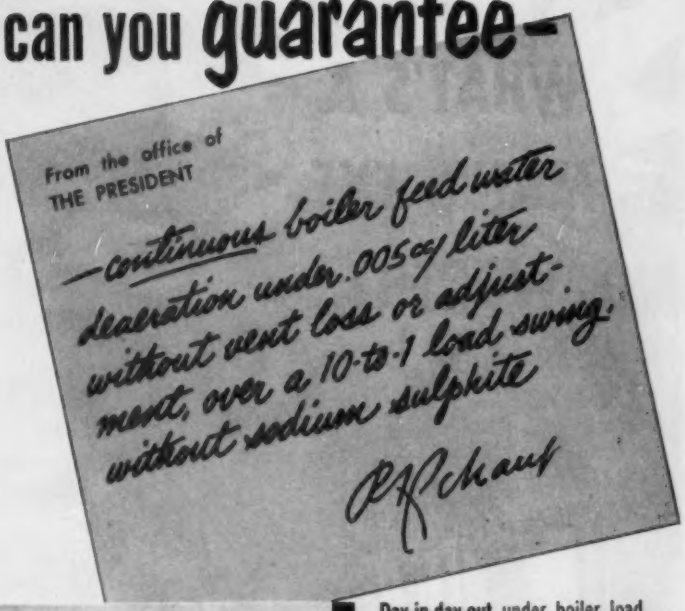
57 **Speed-indicating instrument** is for use with small steam or gas turbines. Principal advantage of indicating device: no mechanical connection needed between device and rotating shaft. By proper design of gear or notched shaft, indicator can be adapted to almost any desired rpm range.—Westinghouse Electric Corporation

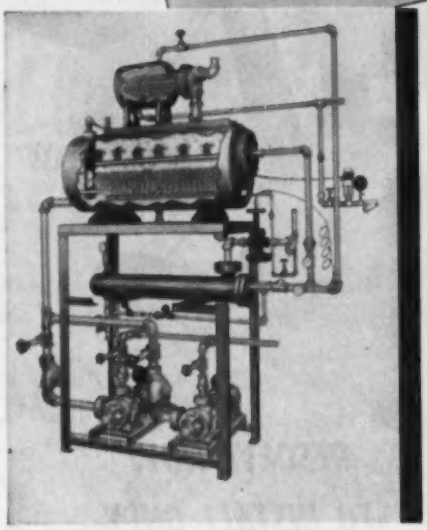
58 **Diesel cold-weather starting aid** is a pencil-like heating device which screws into combustion chambers. You simply push a button on the dash and hold for two to three minutes. Power from the battery raises surface temperature of the heating element to 1800 to 2000 F, heating the fuel to permit easy ignition. Device is sheathed in Inconel tubing to prevent scaling and embrittlement by high temperatures and carbon deposits.—Superior Tube Co

59 **Turbocharger**—small and efficient—has 8-in. housing dia. It's designed for diesel engines in 150- to 350-hp range. Model T-11 lets diesels work at lower peak pressures with better fuel economy. Housing and manifold design uses exhaust-energy gas more efficiently, manufacturer claims. Fewer parts decrease maintenance costs.—Garrett Corp, AiResearch Industrial Div

continued

ONLY with SCHAUB can you guarantee—





Day-in-day-out under boiler load swings as great as 10-to-1—**not** just under favorable fixed test conditions.

Excellent thermal efficiency (insignificant steam vent loss) under **all** regular operating conditions – with no vent adjustment for any load change.

No need for sodium sulphite or other additives. (If you need 'em, you just aren't getting full mechanical deaeration).

Plus at least 6 other savings in operations, maintenance and installation.

All are the result of the unique, but 15-year proved, Schaub design for external superheating, explosive flashdown and fully-vented operation.

SCHAUB ZERO-OXYGEN deaerators

GET THE FULL FACTS—SEE YOUR SCHAUB REPRESENTATIVE OR SEND FOR BULLETIN 575. EITHER WAY YOU WILL PROBABLY CHANGE YOUR IDEAS ON WHAT CONSTITUTES TRUE DEAERATION OF BOILER FEED WATER.

FRED H. SCHAUB ENGINEERING COMPANY
2105 S. Marshall Boulevard, Chicago 23, Illinois

CLIP AND ATTACH TO YOUR LETTERHEAD

Please send my personal copy of Bulletin 575

Name_____

For more facts circle 892 on Reader Service card, p 207

Prime movers

Begins on page 236

60 **Center-line-mounted steam turbine** is available with a variety of frames and wheel diameters. Unit fills requirements to 1000 hp and has steam inlet pressures to 875 psig. Single-stage model is also adaptable to natural-gas expansion and other gases such as Freon. Vertical shaft movement is minimized because shaft mounts at points in same horizontal plane as center line. Thermal expansion occurs from the center line, reportedly cutting problems of radical misalignment between turbine and driven machine (usually caused by unequal expansion of metal in the two machines).—Dean Hill Pump Company

• Prime-mover design aids:

Check off ones you want on Reader Service card, p 207

438 **Center-line-mounted** steam turbine with steam inlet pressures up to 875 psig for requirements to 1000 hp is featured in 2-p bulletin. Dean Hill Pump Company

439 **Ultra-lightweight** gas turbines with 75- to 20,000-hp rating, 300-lb weight are covered in 8-p brochure GEA-7083. General Electric Company

440 **Power-recovery gas-turbine** compressors designed to expand waste process gases to 1250 F are described in 12-p booklet P-10. Elliott Co

441 **M-d turbines** for pumps, compressors, fans and blowers, single-stage types DP and DR, are covered in 16-p bulletin GEA-4955C. General Electric Company

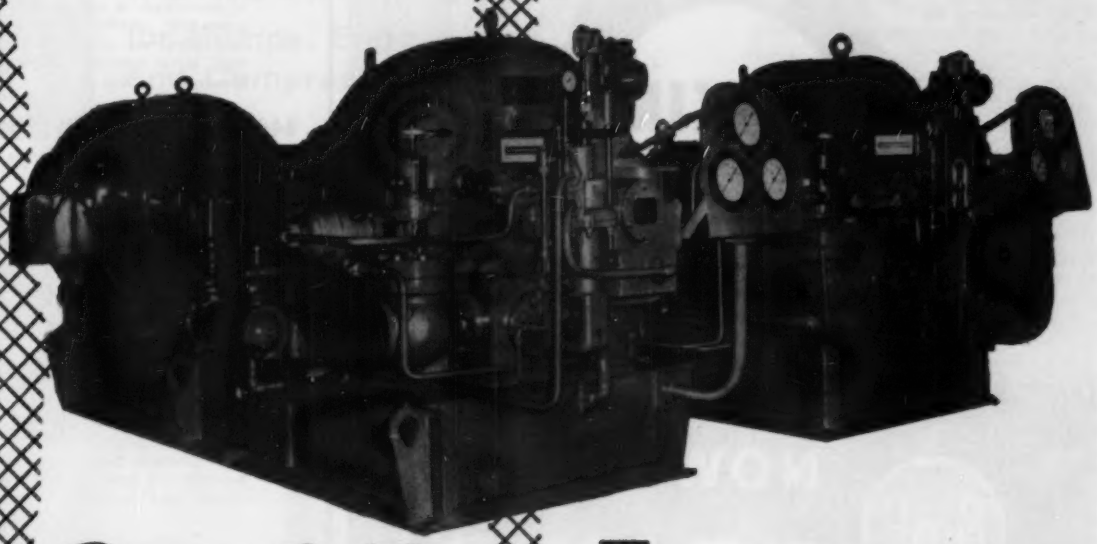
442 **Single-stage** mechanical-drive turbine is center-line mounted to cut shaft misalignment. Handles requirements to 1000 hp, inlet pressures to 875 psig—featured in bulletin 2001. Dean Hill Pump Company

443 **V type 4-cycle engines** operating on diesel, Duafuel or spark-ignition gas are topic of 18-p bulletin 262. Nordberg Mfg Co

444 **New fuel system** which permits diesel engines to burn gaseous fuels including natural gas, sewage gas and diesel oil is explained in brochure EG-B46. Enterprise Engine & Machinery Co

continued

For more facts circle 893 on Reader Service card, p 207



Dependable LOW COST Power PACKAGE FOR THE SMALL PLANT

This pair of 200 KW Murray Turbine generators supply constant, around-the-clock electrical power in a mid-western plant.

The Murray Design 75 — 400 KW Turbine generator sets provide all the safety and economy features of the most modern larger designs — and at the same time offer the advantage of low initial cost and maintenance.

Murray Turbine generator sets can also be furnished in ratings from 500 KW to 3,000 KW. Your Murray Representative will give you details. Write for his name today.

Murray TURBINES

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA

Builders of Steam Power Equipment for Nearly a Century

For more facts circle 894 on Reader Service card, p 207

AMF NOW AT BEAIRD

In full production at AMF-Beaird, Maxim Silencers are the latest to join AMF's industrial family of more than 185 fine products for consumers, industry and defense.

Industrial designers, architects and engineers concerned with noise control will find a new depth in research, engineering and manufacturing facility. AMF's five research laboratories and Beaird's steel fabricating experience in the oil, gas and petrochemical industries assures continuous product improvement.

To put this experienced team on your project . . . contact your nearest Maxim Silencer agent or write direct.

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Prime movers

Begins on page 236

445 **Performance meter,** direct-reading type for diesel, gasoline, natural-gas and steam engines, is described in data sheet. Time-averaged pressure of engine cylinders can be read on meter's dial with engine running. The Korfund Co, Inc

446 **Ten maintenance steps** for engine care are featured in new bulletin. Cummins Engine Company, Inc

447 **Peaking combustion-gas** turbines with 7000- to 28,000-kw range are described in 12-p brochure GED-3761. Operating characteristics, automatic-operation features of the gas turbine are covered. General Electric Company

448 **Turbocharged gas engine,** 2-cycle V type designed as high-hp driver for centrifugal pipeline compressors, generators and liquid pumps, is featured in 26-p bulletin 176. Design features, operating advantages are fully illustrated. Clark Bros Company

Just circle key numbers on Reader Service card, p 207, to get complete story

Coming events

Oct 12-14 — Industrial Management Society, 9th Annual Methods Improvement Contest, 24th Annual Industrial Engineering and Management Clinic, Conrad Hilton Hotel, Chicago, Ill. Details: IMS, 330 S Wells St, Chicago 6, Ill.

Oct 17-19—American Society of Lubrication Engineers, 7th Conference, Statler Hilton Hotel, Boston, Mass. Details: ASLE, 84 E Randolph St, Chicago 1, Ill.

Oct 17-21 — The Metallurgical Society, Fall Meeting, Sheraton Hotel, Philadelphia, Pa. Details: AIME, 29 W 39th St, N. Y. 18, N. Y.

ENGINEERED METAL PACKINGS

for Pumps, Engines and Compressors

Selecting the proper metal packing—and packing ring material—assures positive, efficient sealing against gas, air, steam.

Specifying the right material for metal packings can make a big difference in seal effectiveness and packing life. Garlock offers a wide choice, each designed for specific temperatures and pressures:

GRAPHITIC CAST IRON. Unequaled wear-resistant qualities. Graphite assures continuous lubrication between packing and rod. Recommended against 1500 p.s.i. pressures, 800°F temperatures.

STANDARD HI-LEAD BRONZE. Chosen after years of research, this standard bronze has a yield point of 26,000 lbs./sq. in., a tensile strength of 31,250 lbs./sq. in. Can be used against 10,000 p.s.i. pressures, 800°F temperatures.

HI-LEAD SUPER BRONZE. Possesses a yield point of 14,750 lbs./sq. in., a tensile strength of 25,500 lbs./sq. in. Due to better wear properties, it can be used at pressures to 40,000 p.s.i., temperatures to 800°F.

AMBERITE—PLAIN OR GRAPHITIZED. Tough, strong, high impact strength. Excellent where corrosion and mildly difficult lubricant and wear conditions exist. Apply against 600 p.s.i. pressures, 250°F temperatures. Other grades available to meet various conditions.

BABBITT. Used on soft rods and where corrosion is present, lubrication is limited. Standard Babbitt has tensile strength of 10,000 lbs./sq. in. More expensive type has better wear qualities. Recommended for 5000 p.s.i. pressures, 425°F temperatures.

CARBON. Used where no lubricant is allowed. Generally affords the best wear-strength combination available. 700°F is recommended temperature limit; pressures may vary according to grade of carbon used.

TEFLON.* Far superior to many other rod packing materials because of outstanding chemical resistance, ability to retard wear and friction. Available in carbon- or glass-filled.

GARLOCK

Discuss metal packing materials with your Garlock representative. Call him at the nearest of Garlock's 26 sales offices and warehouses throughout the U. S. and Canada. Or, write for Catalog AD-166. Garlock Inc., Palmyra, N. Y.

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Co.

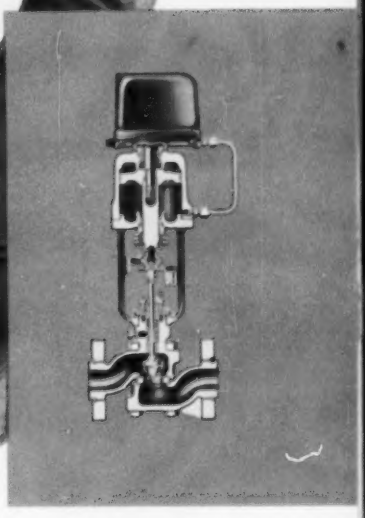
Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded & Extruded Rubber, Plastic Products

*Du Pont Trademark for TFE Fluorocarbon Resin

Compact...Powerful...

FISHER
SERIES
470 P.O.P.

PNEUMATICALLY OPERATED PISTON



SPLIT BODY CONSTRUCTION

Type 470-Z Actuator with a Split body. P.O.P. is also ideal for three way bodies and large single port globe or angle bodies. Only Fisher gives you such a wide selection of actuator-body combinations.,

Piston Actuator for Control Valves

does jobs that once required giant size equipment!

POWER—Thrusts up to 17,500 pounds available. Delivers same power in either direction at any point of the stroke.

ACCURACY—Maximum Hysteresis 0.15% of stroke or signal. Repeatability 0.03% of stroke or signal. Resolution Sensitivity 0.02% of instrument signal.

SPEED—4 inches per second stroking speed with the Size 30. Size 60 provides 1.5 inches per second.

STABILITY—Built-in intermediate feedback causes proportional band of positioner to be broad while instrument changes are taking place, yet narrow when unit is not in motion.

Here's power plus in a small package! This compact Fisher 470 Series has its own positioner mounted integrally on top of the cylinder. Positioner receives any of the normally used pneumatic instrument signals. Then, without an air set, actuator utilizes the full potential of the available air or gas supply (up to 150 psi) to provide exceptional speed and power.

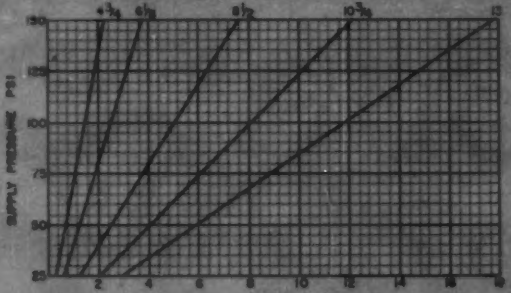
Series 470 is adaptable to virtually all types of valve bodies including butterfly valves. Easily reversible actuator can be changed in the field. Available in six basic sizes and can be supplied for travel up to 4". Basic actuator can also be furnished with a handjack, hydraulic snubber, pneumatic safety devices or as a spring return unit . . . **Write for Bulletin E470.**

BRACKET MOUNTED SERIES 480 P.O.P.

The versatility of Fisher's P.O.P. actuators is further highlighted in the bracket mounted Series 480. The Series 480 provides a compact, powerful actuator for the operation of butterfly valves, louvers, large rheostats and similar equipment found in many industrial applications.

AVAILABLE STEM FORCE

CYLINDER DIAMETERS AS MARKED ON EACH CURVE



Besides the five basic sizes shown by the curves, a 17 inch cylinder can be supplied to provide thrusts of 12,000 pounds with a supply pressure of only 60 psi.

SPRING RETURN ACTUATOR

Type 473 Actuator with spring safety device. In event of a supply pressure failure control valve will move into the closed position. Also available with spring for return to open position in event of plant air failure.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880

(Advertisement)

".....we knew you would want all these switchgear advances. And we were determined to bring them to you at the lowest possible cost."

—Frederick G. Schmidt, Manager Switchgear Division, I-T-E Circuit Breaker Company

Frankly, we had a big decision to make when we were designing this new HK metal-clad switchgear. Should we go ahead with a complete redesign or should we simply add the new features we knew you wanted to our previous models? The latter would have been easier, and it still would have put us well ahead of the field. But we decided it would be more honest to give you the benefit of as much progress as possible as soon as we could. And we were confident that in this case we could give you all these advances at a price no higher than you would pay for equipment with none of them.

First we wanted to give you stored energy closing. No circuit breaker in this class can really be called modern today without this feature. It insures that you can have fast, uniform closing every time. In fact, I-T-E makes it possible for you to close the breaker even during emergencies when you have lost control power. Fast closing reduces breaker upkeep—prolongs contact life. And I-T-E's motor-driven spring charging mechanism needs only about one-tenth the power of other devices. So you can enjoy the economy of a smaller battery or control transformer.

To give you still greater safety too—again with no increase in cost—we designed this switchgear so you never need open the doors to move the breakers. You can go all the way from connected through test position, to disconnected, and back again with the door closed. Where else can you find safety like this in metal-clad switchgear? Even an inexperienced man can operate it in complete safety. Because we were designing this equipment completely new from the ground up, we had the opportunity to make the components more accessible and provided more elbow room inside the compartments. The bus is higher, for example, making installation and inspection easier. The control cables are brought in at the front for convenience and safe access away from the high-voltage bus. The current transformers are located behind the shutter in the circuit breaker compartment and may be easily changed without disassembling the bus or cable connections.

We were meticulous from the beginning about taking full advantage of the many new materials now available for switchgear use. And through careful selection of materials, skillful arrangement of components, and shrewd economy of space, we were able to give you all these advances in a substantially smaller package as standard equipment. The gear fits under lower overheads and in narrower aisles. Yet it gives you actually more usable space inside than you had before. Circuit breakers are lower, lighter and easier to handle. Instruments are at eye level. We believe you will agree there is no finer switchgear available today anywhere.

A complete description of this equipment is contained in our new illustrated Bulletin 2801-2A. Send for your copy. And ask to see our new sound strip film. We'll bring it to your office. You can see it in 18 minutes. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

For more facts circle 800 on Reader Service card

● Maintenance equipment: For details, circle key numbers, p 207

61 **Plasma-flame spray gun** sprays any material that melts without decomposing. Normal work temperatures are 10,000 to 15,000 F. Using the plasma-arc principle, gun applies coatings of high-melting-point materials: zirconium carbide (3540 F), tungsten carbide (2850 F), zirconium boride (3000 F), niobium carbide (3900 F) and other oxides, borides and carbides.—Metallizing Engineering Co, Inc

62 **Do-it-yourself carbides** may be machined, offer unusual resistance to heat and moisture, says maker. Now carbide parts and tools to withstand high temperatures and corrosive media can be produced right in the shop. Steel-bonded carbides come in two grades, both produced by powder-metallurgy techniques, embedding tiny crystals of extremely hard titanium carbide in soft matrix of stainless steel. Applications: valves, valve seats, pump seals and high-temperature bearings. —Chromalloy Corp, Sintercast Div

63 **Protective soldering cream** increases activity of flux without use of mineral acids, protects soldered metal from corrosion. Use it on phosphor bronze, tinned steel, galvanized iron, copper, brass and for sweating jobs. It gives off no toxic fumes and should be safe under any conditions.—Farrelloy Company

64 **Heavy-duty manual torch** uses heat of electric arc to melt metal, stream of compressed air to blow it away. It is especially handy for fast removal of large areas of metal. Well-insulated unit has sleeve of silicone-glass laminate on torch handle, rubber hoot for connection on end of cable.—Arcair Co

65 **Portable in-place balancer** consists of a strobe and meter, electronic unit, vibration pickup, tripod and carrying case. Balancer operates on 115-v 60-cycle single-phase current. Stroboscope and meter indicate angle of unbalance and amount of vibration. For 1-man operation, you can read meter and strobe together—they're mounted in the same portable head which can be set anywhere so operator has a hand free for other work. Balancer first determines rpm and amount of vibration. Then it pinpoints trouble source by freezing image of rotating part with strobe light. Sensitivity is adjustable from below 10-millionths of an inch to over 1/10-in. amplitude of vibration.—Stewart-Warner Corporation

66 **Safe, easy-to-use descaler** is made with sulfamic acid and inhibitors that clean and dissolve scale without corroding or damaging metal, according to the maker. Built-in color indicator shows when acid is used up. A dry crystalline material, descaler cannot splash when handling. If any spills, you simply shovel it up. Recommended for boilers, heaters, evaporators, air conditioners, steam generators and diesel-cooling systems.—Dearborn Chemical Company

67 **Thread-milling attachment** lets any lathe thread-mill internally and externally. Plastics are threaded without distortion; beryllium, stainless steel and titanium can be handled. Low-cost unit holds pitch and root diameters to close tolerance of .001 in. Cutters range from ½ to 9 in. for internal, 1/32 to 9 in. for external threading. An unskilled person completes threading setup in five minutes.—Fen-Thread Machine Co, Inc

68 **Epoxy tooling** and repair compound comes in two types, puttylike (No. 100) and liquid (No. 101). Both varieties boast good tensile and compressive strength, resist most chemicals and oils. They'll bond to metals, wood, ceramics. High strength, light weight suggest use in repairing damaged machinery, foundry patterns, core boxes.—Devcon Corporation

69 **Heat-treating package** comes complete to tackle preventive maintenance. A 2-position quench type work station, radio-frequency power-transfer switchgear, vertical progressive scanning machine and induction generator are packaged to handle all hardening jobs from cams and gears to components 6-ft long, ten in. in diameter. Package takes only 10x20-ft floor space. The Ther-Monic features a series of eight checklights to pinpoint abnormal conditions, cut troubleshooting headaches. A built-in air-conditioning system lets you use this induction heat-treating package under any ambient temperature.—Induction Heating Corp

70 **Self-contained ultrasonic degreaser** is said to remove metal chips, grease and certain solubles even from intricate parts. Generators, cleaning chambers, rinsing tanks are combined—only water and 110-v 60-cycle electrical connections are needed outside unit. Degreaser measures 44x18x36 in. All parts in contact with solvent are made of stainless steel or plastic. Interlocks shut off power when access door is open. —Branson Ultrasonic Corporation

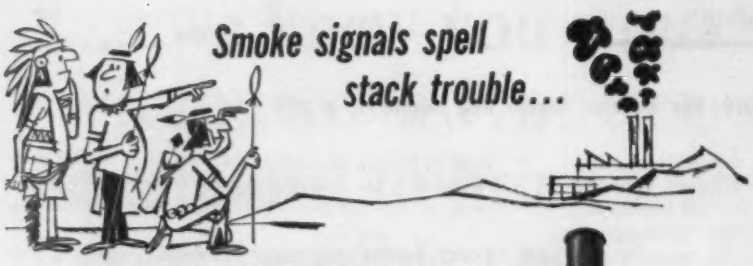
71 **Ultrasonic cleaning unit** for use where high-energy-density cleaning is required features a 5-gal heavy-gage polished stainless-steel tank 12-in. long, 12-in. deep and 9-in. wide. A 115-v ac single-phase 60-cycle generator, designed for continuous operation, delivers average power output of 250 w, peaks of 1000 w.—National Ultrasonic Corporation

72 **Pocket-sized needle gun** meets requirements of cleaning, descaling and derusting jobs, particularly in small and confined places. Lightweight gun is air-operated. It consumes maximum of only 4.8-cu-ft air per min. Weight is 3.3 lb.—The Marindus Company, Inc

73 **Drum-filling cover** cuts dangerous and costly spillage. Plastic cover collects and holds overflow due to fill-line breakdowns, leaky valves and careless operators. Corrosionproof, unbreakable polyethylene cover is available in 15-, 30- and 55-gal sizes to fit all standard fill lines on steel, fiber and polyethylene drums.—Delaware Barrel & Drum Company, Inc

74 **Drum-support bar** cradles 55-gal drums for easier movement and placement by fork-lift trucks. Safety support beam has welded stops at top of flange. You can incorporate support beam in adjustable storage rack and attach it to upright frames quickly and easily with a floating wedge lock, use it for bulk or drum storage.—Union Asbestos & Rubber Co. Sturdi-Bilt Material Handling Div

continued

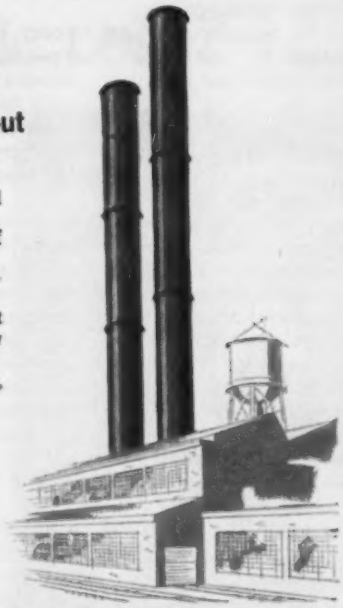


unless you're equipped with A. O. Smith smokestacks . . . glass-protected inside and out

Glass-protected smokestacks give you:

- A selection of colors
- 3 to 5 times longer life than unlined steel stacks
- Corrosion resistance regardless of excess acid condensate
- Low maintenance, no painting — glass can't rust
- Light weight—lower foundation cost
- Lower cost — glass protection now within reach of all

For bulletin containing all the facts, write Dept. CE-40.



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A.O.Smith
CORPORATION

SMOKESTACK SALES
PROCESS EQUIPMENT DIVISION
P. O. BOX 584 • MILWAUKEE 1, WISCONSIN

For more facts circle 896 on Reader Service card, p 207

One of the two 380-ton MURCO Gate Hoists furnished to the Power Authority of the State of New York.

Each hoist operates a gate 46' wide by 67' high at one foot per minute. These gates divert the water from the Niagara River above the Falls into covered conduits five miles long. The two conduits bring the water to the Niagara Generating Plant on the United States side of the Falls.

The engineers on this project are Uhl, Hall Rich of Boston, Massachusetts.

MURCO Gate Hoists are designed and made for any size power dam . . . capacities from less than 1 ton to over 375 tons . . . from the smallest hand operated to the largest motor operated gate hoist, all made to specifications.

Write for complete information . . . Engineering Department recommendations . . . when you are planning power dam projects.

D. J. MURRAY MANUFACTURING CO.
Manufacturers Since 1883
WAUSAU, WISCONSIN

For more facts circle 897 on Reader Service card, p 207

Maintenance

Begins on page 245

75 **Pressurized dry-chemical** hose rack extinguishers can be used on flammable liquid, gas and electrical fires. 200- and 400-lb units can be floor-, wall- or truck-mounted. Nozzle discharges for a range of 40 ft. Hose lengths: 50 or 100 ft.—Walter Kidde & Co, Inc

76 **Air silencer** is absorption type having perforated air-passage tube entirely closed by sound-absorption material encased in outer shell. Unit is leak resistant with continuous welded seams, double-seal crimped ends and female pipe connections on both ends. You can use it for temperatures up to 210 F.—Universal Silencer Corporation

77 **Carbon-arc lead burner,** easily toted in a mechanic's tool box, is designed for on-the-job repairs to industrial storage batteries and for general heating jobs. Power can come right from the battery being repaired or even from an ordinary automotive battery. Equipped with a pencil-tip carbon heating rod to melt the lead, burner is fast and convenient for removing connectors. Its concentrated heat can be applied to hard-to-reach parts for such jobs as melting a soldered electrical connection.—Electric Storage Battery Company, Exide Industrial Div

78 **New spraying outfit** uses Freon-TF solvent to clean electric motors in place. Air-operated pump mounts directly on unpressurized material drum. Pump speed is controlled by air-adjustment valve. Maximum air requirements are three to six cfm.—Binks Mfg Co

• Maintenance design aids:

Check off ones you want on Reader Service card, p 207

449 **Nondestructive-testing** equipment is topic of 12-p booklet giving facts on X-ray test units. Philips Electronic Instruments

450 **Transistorized** pipe, valve and cable locator is described in 2-p brochure. Gardiner Electronics Company

continued

End corrosion in gasket inventory

The gold Flexite Finish* for the metal gauge rings in Flexitallic Compression-Gauge Gaskets is new. It is highly corrosion resistant when exposed to severest weathering in open construction projects or in stock. The Flexite Finish provides for ease of identification and a clean, long-lived installation. Write for samples.

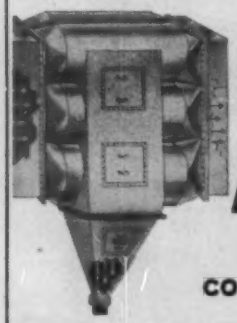
FLEXITALLIC GASKET CO., 8th & Bailey Sts., Camden 2, N. J.
Representatives in Principal Cities

TRADE Flexitallic MARK
SPIRAL-WOUND GASKETS
WITH Flexite FINISH

*The gold Flexite Finish is a development of the Flexitallic Gasket Co. (Originators of Spiral Wound Construction) – Register applied for on both name and color. Flexitallic Blue is our exclusive blue-dyed Canadian asbestos filler. Look for the blue and gold color combination as the mark of Flexitallic quality.

For more facts circle 898 on Reader Service card, p 207

REGENERATIVE



FLY ASH COLLECTOR

★ Removes Fly Ash, Soot and Cinders from Stack Gases

★ For Natural or Induced Draft

★ High Efficiency at All Loads

★ For All Plant Arrangements and Sizes

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BRESLOVE SEPARATOR COMPANY

COMMONWEALTH BUILDING

PITTSBURGH 22, PA.

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LOOK CHIEF . . . . NO HANDS!

No stop watch, either. Madden takes all the guesswork out of blowing boilers by continuously bleeding a measured amount from the boiler. Madden watchdogs your dollars all the way by removing practically all the heat from the blowdown . . . even gives you clean dry steam that can be used for many purposes. All this with no maintenance! Exclusive self-flushing gravity flow of dirty blowdown water assures absolutely clean coils and peak performance all the time. Write for a copy of "Modern Blowdown". *The Madden Corporation, 1345 Jarvis Ave., Chicago 26, Ill.*

circle 900 on Reader Service card, p 207

Maintenance

Begins on page 245

451 **Rust and corrosion control** is topic of 38-p systems catalog. Discussion of control by colorful protective coatings is feature. 110 color chips show actual colors. Rust-Oleum Corp

452 **Firm's catalog** lists 1000 official U.S. Government specs covering adhesives, paints, cleaning and chemical compounds. Magic Chemical Company

453 **Ultrasonic cleaning equipment** for flat and convoluted metal filter-element surfaces is described in 22-p technical report. Aircraft Porous Media, Inc

454 **Safety-cleaning solvents** for electric motors, components, generators, controllers are topic of info sheet. Harco Chemical Company

455 **Steel-spring machinery mounts,** data on stopping vibration, shock and noise transmission are covered in 8-p bulletin K3C. The Korfund Co, Inc

456 **Obtaining effective damping** in structures, test fixtures is explained in 4-p folder. Barry Controls, Inc

457 **Control and measurement** equipment for vibration, shock and noise is described in 8-p brochure K4G. Korfund Co, Inc

458 **Conditioner** keeps spray guns ready for use—described in folder. Wisconsin Laboratories, Inc

459 **Liquid compound** for steam, emulsion, immersion, ultrasonic and wipe-on cleaning is introduced in technical literature. Turco Products, Inc

460 **Metal treatment** stops rust, bonds metal and paint—introduced in 4-p folder. Rusticide Products Co

461 **Hoists, hoist cranes** are featured in 4-p bulletin, specs included. Northern Engineering Works

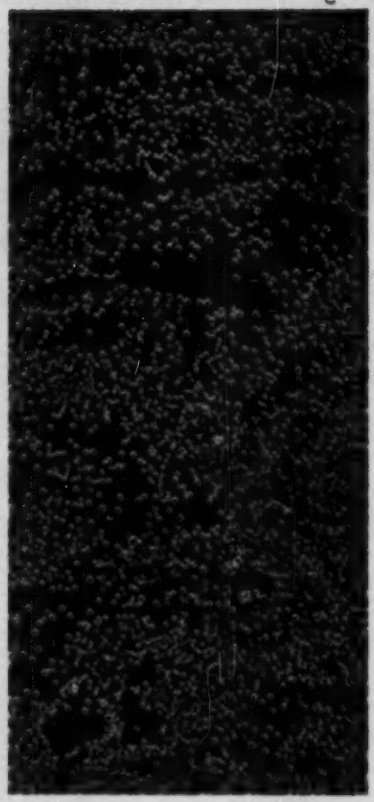
462 **Hand chain hoists** covered with specs in 8-p bulletin. Hoist Manufacturers Association, Inc

463 **Wire rope** varieties and applications are discussed in five 4-p new-product bulletins. Strength and size specs listed. Jones & Laughlin Steel Corporation

464 **Pipe-marking device** is announced in 4-p bulletin, price info included. Tool and Equipment Company

465 **Progress report** on continuous fluoroscopic inspection of arc-welded pipeline is available from Phillips Electronic Instruments

466 **Electronic probe** to locate and measure noise and vibration in



DEOXY-SOL REDUCES OXIDES

in boiler feed water yet adds no solids

– and that may be a good reason to select DEOXY-SOL for treatment of your boiler water. But it provides other advantages also.

DEOXY-SOL is a high efficiency oxygen scavenger, since it is a solution of hydrazine. And it raises the pH, supplementing any amine treatment.

Stocks in Newark, N. J., Chicago, Ill., Los Angeles, Calif.

Write for informative Bulletin BW.

Fairmount

CHEMICAL CO., INC.

circle 901 on Reader Service card, p 207

COPPUS BLUE RIBBON PRODUCTS

Coppus Steam Turbine with Built-In Speed Reducer

STAMINA — You can literally *see* stamina in every dimension of a Coppus Turbine . . . rugged reliability that assures you stable, positive performance. It truly "wins" the Blue Ribbon with which it is marked . . . through advanced design, top quality materials, and thorough testing. With Coppus you're always certain of Blue Ribbon features such as these —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Sizes from 1 HP to 250 HP. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 170 Park Ave., Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES

For more facts circle 902 on Reader Service card, p 207

SARCO TOPICS

HOW TO PREVENT FREEZING OF HEATING COILS

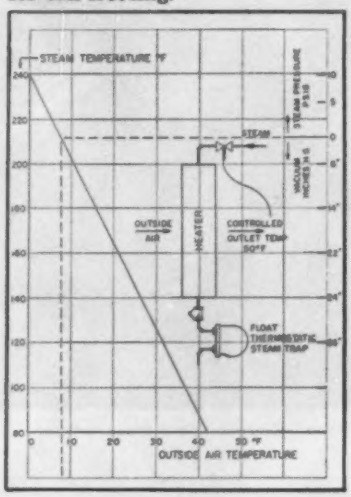
Despite the *best* "non-freeze" construction, air heating coils handling incoming air even slightly below 32° F are subject to freezing—*if they're not properly drained.*

Are traps to blame?

Under such conditions it is easily assumed that steam trap capacity is inadequate. However, there are other, more likely reasons. Since the discharge capacity of a steam trap depends upon the pressure differential between trap inlet and outlet, a zero pressure difference will result in zero capacity, no matter how large the valve seat is.

Why coils freeze

If the pressure at the trap inlet falls lower than pressure at the outlet, condensate cannot be discharged and will be held back in the coil. Condensate held in the coil is bound to freeze if the temperature of the air is below 32° F. As an example, consider a preheat coil designed to heat air from 0° F to 50° F, using steam at a maximum pressure of 10 psig. The chart below indicates that, as the outside air temperature rises above 0°F, the heat demand decreases, the temperature *controller reduces the steam pressure* to compensate for this reduced heat demand—and the stage is set for coil freezing.



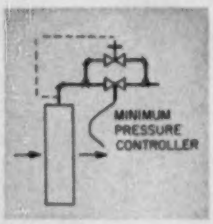
At left: chart shows how steam pressure in the heater is decreased by the modulating control as outside air temperature increases. Note that when outside air temperature reaches 7° F the pressure drops to 0 psig. In other words, unless special provisions are made there will be no pressure difference across the steam trap.

The remedy: 3 practical hook-ups

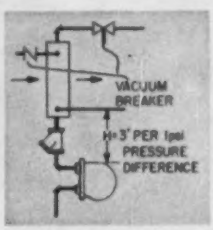
Starting with a correctly sized steam trap—and the Sarco Float Thermostatic is recommended as best suited to this type of application—freezing can be cured by preventing the pressure differential across the trap from falling below the minimum needed to discharge all the condensate as rapidly as it forms. Here are three practical methods.

1. Arrange a pressure controlled bypass around the temperature control valve

This keeps the pressure in the heater from falling below a preset minimum. With this solution, however, the temperature controller is not effective over the full range of outside air temperature.



Schematic hookup for pressure controlled bypass around temperature control valve.



Hookup for installing steam trap below unit.

2. Install the steam trap well below the unit

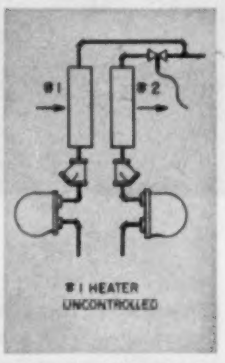
This provides a hydraulic leg which allows the trap to discharge even with a vacuum in the steam space. A vacuum breaker should be installed at the top of the condensate header of the heater. To calculate the hydraulic head needed, use 3' per 1 psi pressure differential.

Example: if trap has required capacity at 1 psi differential, minimum head is 3'.

3. For a new installation, divide the preheater into two sections

The first section should be capable of raising the air to at least 32° F under minimum outside air conditions and the second to raise the air from 32°F to the final temperature. The first coil would be supplied with steam at full pressure at all times, while the second would be controlled to maintain the final temperature needed. The first coil could not freeze because of steadily maintained pressure, and the second would not freeze because the air temperature would be above 32° F.

2171



Hookup for dividing preheater into two sections.

FIGURE IT OUT AT A GLANCE. "FREEZING POINT DANGER KIT" — FREE. Contact your Sarco Sales Representative, or write

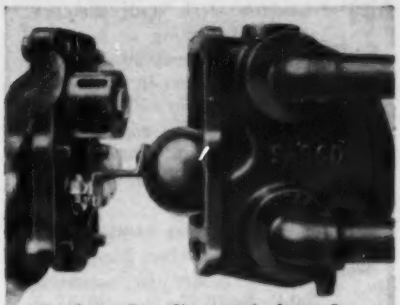
SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

For more facts circle 903 on Reader Service card, p 207

SARCO



The Sarco Float Thermostatic Steam Trap cannot air bind, because its high-capacity air vent automatically discharges all air as rapidly as it reaches the trap. Requires no adjustment when pressures change. Available for steam pressures to 200 psi.

FOR CONTINUOUS DRAINING AND VENTING ...SARCO FT STEAM TRAP

When you install the Sarco Float-Thermostatic Steam Trap you can depend upon it to discharge condensate continuously, at steam temperature, completely and without shock. Its thermostatic air vent removes immediately and automatically all air and incondensable gases reaching the trap. The FT never interferes with temperature regulation—because it never causes pressure fluctuations in the space being drained.

That's why the Sarco Type FT meets the special trapping requirements of heating coils—as well as steam main drips, unit heaters, heat exchangers, and other applications demanding accurate temperature control.

WRITE FOR SARCO FT BULLETIN

Remember that Sarco can give you *impartial* advice on steam trapping because *only* Sarco makes all 5 types: Float-Thermostatic...Thermostatic . . . Liquid Expansion . . . Thermo-Dynamic . . . Bucket.

2170

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

circle 904 on Reader Service card, p 207

machines and mechanical systems is detailed in data sheet. Erwood Inc

467 **Ultrasonic cleaning** is subject of 4-p bulletin 16A. Explains method and compounds used. Oakite Products, Inc

● Insulation and coatings

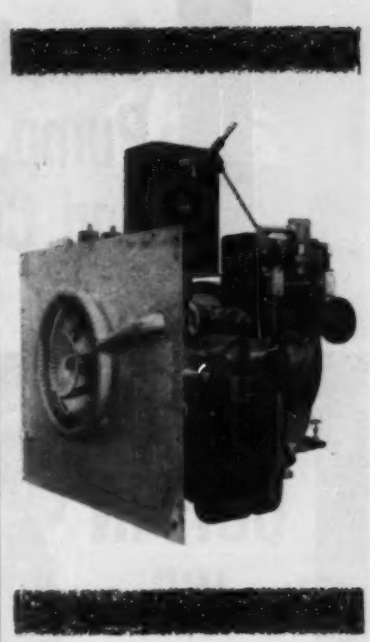
Check off ones you want on Reader Service card, p 207

79 **Incombustible asbestos board** insulates ductwork, firewalls, fireproofs structural material, heat screens and h-t test chambers, among other applications. Work it like wood—saw, plane, sand or drill it; it holds nails or screws. Structural properties stand up under water. Compressive strength: 2400 psi; density: 35 lb. Available in 1- to 3-in. thicknesses.—Union Asbestos & Rubber Company

80 **Insulation envelope** of coated Dacron protects wires, cables or pipes subjected to extreme hot spots. Insulation zips on—one man can do the job. It will withstand temperatures to 300 F for 100 hr or more, 400 to 450 F for ten minutes. Envelopes come in all sizes in a variety of thicknesses. —The Zippertubing Company

81 **Plastic-ceramic material** has high heat-resistant properties. Resin-bonded-quartz sheet has finely divided particles of fused quartz bonded together with high-temperature-resistant Pyropreg resin. Small percentage of glass or other fibers is included for good handling properties. Firm recommends using as a facing on a laminate of Pyropreg-reinforced plastic. Fused-quartz particles have low coefficient of thermal expansion. When melted, liquid acts as insulator for unmelted material.—Cordo Chemical Corp

continued



NEW . . . FABER'S COMPACT PACKAGE OIL-GAS-OR COMBINATION BURNER

Faber's rugged new "AF" Packaged Burner—field tested over 5 years' continuous duty—offers these advantages:

COMPACT • Unique space-saving design integrates burner, blower and controls. All components accessible for inspection or maintenance.

EFFICIENT • Unique axial flow, hollow shaft forced draft fan, adjustable curved vane air register and Voltrol fan inlet vanes for efficient turbulent fuel-air mix over wide range.

ADAPTABLE • Fan unit and "V" belt drive adjustable to heavier load for modest plant expansion. Motor, turbine or combination drive. Fully automatic, semi-automatic or manual controls. Standard electric drive with oil immersed gears and heavy duty motor develops 100 ft pounds of torque. Hydraulic or pneumatic controls available.

SAFE • Complete programming unit for flame safeguard, interlocked with safety circuit.

Write for Faber Catalog 59-1:
FABER ENGINEERING CO., Inc.
240 West Washington Street,
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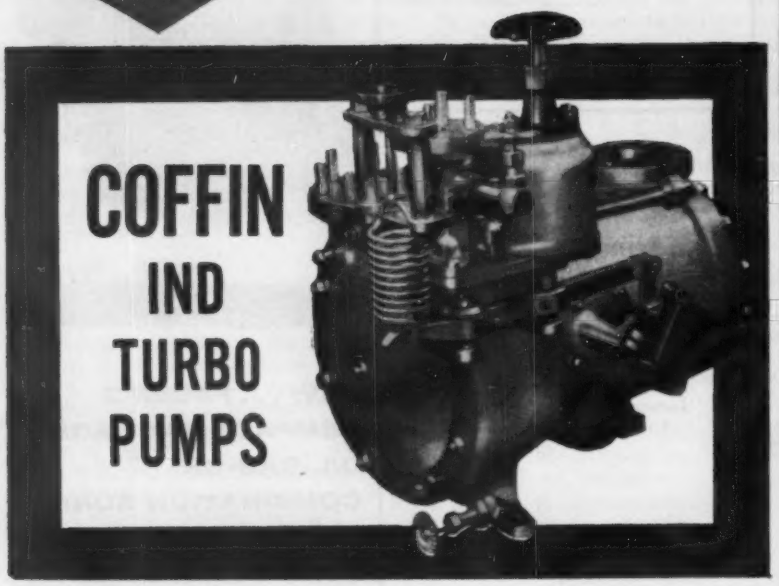
or any handy Faber dealership

FABER
ENGINEERING COMPANY, INC.

Manufacturers of Industrial Oil and Gas Burners, Fuel Oil Pump and Heater Units, Special Pumping Units, Since 1927 F-197

circle 905 on Reader Service card, p 207

Complete Pump, Turbine and Controls



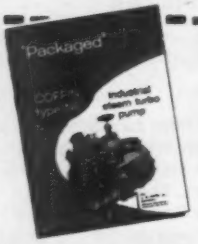
PACKAGED — integral design of the IND Pump results in a compact, highly efficient unit which mounts impeller and turbine wheel on a short, rigid shaft. The unit is equipped with complete controls for constant or differential pressure regulation.

APPLICATIONS — compact and highly efficient, the Coffin type IND Steam Turbo Pump is designed for General Boiler Feed or any other pumping service where medium volume and high pressure is required.

SPECIFICATIONS-

Capacities to 185 GPM	Discharge Press. to 350 PSIG	Height 32"
Steam Pressures to 300 PSIG	Steam Temp. to 750°FTT	Width 25"
Exhaust Pressures to 60 PSIG	Liquid Temp. to 300°F	Length 32"

For special installations these ratings may be exceeded.



Coffin Turbo Pump Co.
326 South Dean Street, Englewood, N. J.

Gentlemen: Please send me illustrated booklet further describing the Type "IND" Pump.

Name _____
Position _____
Company _____
Street _____
City _____ Zone ____ State _____

fmc

COFFIN TURBO PUMP
Hydrodynamics Division
FOOD MACHINERY AND CHEMICAL CORPORATION
326 South Dean Street • Englewood, New Jersey
Agents in all Principal Cities • Cable Address: COFCO

For more facts circle 906 on Reader Service card, p 207

Insulation

82 **Asbestos cloth** with 0.0004-in. aluminum coating is laminated with a heat-resistant adhesive. Flexible combination is more than 90% effective in reflecting radiant heat. In tape form it is highly adaptable as an outer wrap for pipe lines.—Johns-Manville Co

83 **N-700 insulating block** is made of h-t mineral fibers bonded with phenolic binder for service to 700 F. Resilience lets it fit snugly over surface irregularities to cut heat loss. Block is attached by impaling on weld pins, or with cross-latched wiring or banding. Weight: under one lb per board ft. Low k-factor: .371 at 400-F mean temperature. Dry-process manufacture is said to cut cost.—Forty-Eight Insulations, Inc

84 **Protective-coating formula** based on synthetic resins is said to withstand influence of acids and alkalis at saturated temperatures up to 300 F. First developed by a German engineer, Sakaphen is now available to the American market. According to manufacturer, resistance to dew-point corrosion is excellent. Protection for metal and concrete surfaces—chimneys, precipitators—is suggested application.—American Sakaphen Corporation

• Insulation and coating design aids

Just circle key numbers on the Reader Service card, page 207, to get complete product story

468 **Insulating channel** and angle stock for structural applications is described in folder. Shows how high-strength fiberglass-reinforced polyester shapes can replace stand-off insulators, wood and insulating metallic members. The Glastic Corp

469 **Insulating block N-700** is topic of bulletin 501. Block boasts low k-factor, low cost, low weight. Forty-Eight Insulations, Inc

470 **Fibrated epoxy-mastic** coating for equipment and structure pro-

Begins on page 251

tection is topic of bulletin 540A. Prufcoat Laboratories, Inc

471 **Adhesives and coatings** for insulating applications, methods for selecting right product are treated in 4-p folder. Insul-Coustic Corp

472 **Refractories,** chrome-mortar and chrome-castable type, are featured in spec sheets 72, 73. H K Porter Co, Inc

473 **Fiber-glass** pipe-fitting insulation is described in brochure TD-105. Design features, dimensional data, specs are given. Pall Corp

474 **Insulations** for service from sub-zero to 1900 F are presented in 24-p catalog of recently merged firm's complete line. Selection chart indicates temperature range of various types of materials. Baldwin-Ehret-Hill, Incorporated

475 **Coatings** of high-melting-point materials, metals, ceramics and carbides are topic of 16-p engineering-data bulletin. Flame-spraying process is covered. Metallizing Engineering Co

Lubrication

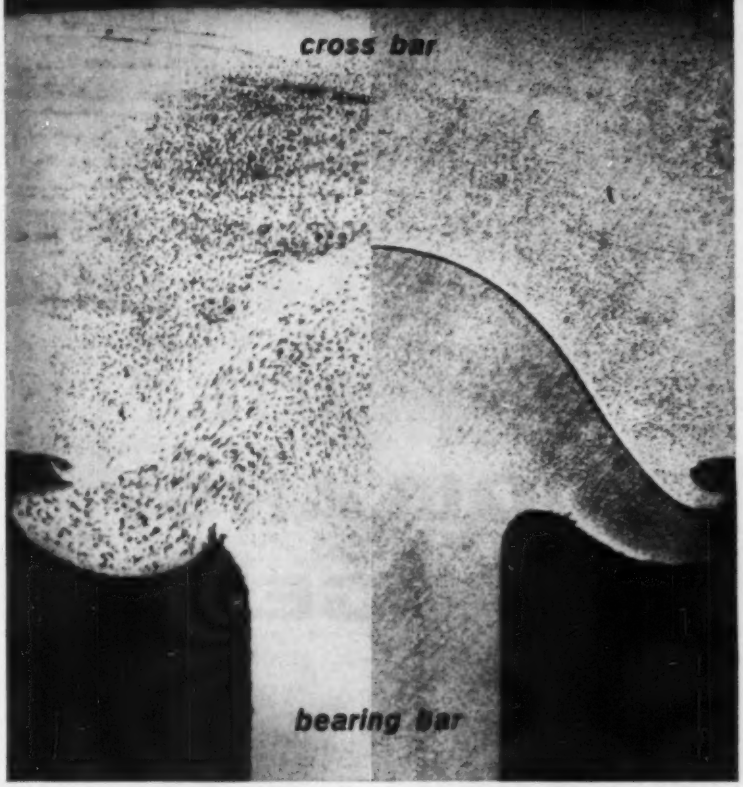
Just circle key numbers on the Reader Service card, page 207, to get complete product story

85 **Molybdenum-disulfide lube** is for extreme-pressure and wear-reduction applications. Because pressure characteristics do not come from fusion of additives at elevated temperatures, this lube is suitable for slow-moving parts, surfaces which would react with additives. No settling occurred when different dilutions were tested for stability at 140 F.— The Alpha-Molykote Corp

86 **Lubricant-testing machine** tests dry or liquid lubes at ambient to high temperatures. Unit uses oscillatory or rotational motion. H-t furnace, 5-hp motor and protective electrical equipment are included.— The Alpha-Molykote Corp

continued

this or this



This is Dravo Tru-Weld Grating. In this cross section of a cross bar-bearing bar weld, the metal has fused together. There are no gaps to admit moisture or weaken the joint. It cannot come apart.

Here fusion of metals is incomplete. There is a noticeable gap between bearing bar and cross bar, an open invitation to internal corrosion which can weaken the joint and add to maintenance costs.

which weld for your grating?

Tru-Weld grating is stronger because it is *made* that way. Its added strength comes from a manufacturing process that completely fuses the metal at cross bar-bearing bar joints and holds the bars to exact spacing. The result is grating that stands up under excessive vibration, heavy traffic or in areas where corrosive fumes and moisture are a problem. And Dravo Tru-Weld grating *costs no more.*

Complete estimating, layout and fabricating services are available. Immediate delivery from stocks maintained at nearby Joseph T. Ryerson Service Centers will help you meet exacting construction schedules.

For more information on this new, stronger grating, call the Dravo representative in your area, or write DRAVO CORPORATION, PITTSBURGH 25, PA.

DRAVO
CORPORATION

For more facts circle 907 on Reader Service card, p 207

how much
does a 4-second
power loss
cost you
in
DAMAGE?
DOLLARS?
DANGER?

A certain engine manufacturer loses his electronic mind in even 4-second power failures that stop data processing equipment. The wizardry of today's computers has this disadvantage: without power, the computer may lose its memory and there may be wide spread damage to tubes, relays and other sensitive devices.

Result: costly delays in recording data again and possible equipment damage.

Any industry — steel, aircraft, petrochemical, banking, food — that uses data processing equipment in its operations faces the same damage, dollars and danger as the price of power loss for even a few seconds.

Power with absolutely no interruption

Condec's UPS (Uninterrupted Power Supply) eliminates this problem completely because it provides power without interruption, full voltage restoration in 1.5 milliseconds. Frequency is maintained within 1% during operation, within 3% in transition. Synchronization is automatic, operation is unattended. Units from 5 to 200 kw.

Where UPS can help you

Wherever your manufacturing depends on power, Condec's UPS wipes out the hazards of danger, damage or dollars that can be caused by even 1-second power losses. For more information, or a free demonstration at our plant, write or call Mr. Frank Cesario, Consolidated Diesel Electric Corporation; telephone DAvis 5-2261.

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Lubrication

87 **Three antiseize and lube compounds** are available. (1) One prevents seizing and galling regardless of applied load on threaded parts at temperatures up to 2100 F. It reduces takeup torque and won't drip off red-hot surfaces. (2) Antiseizing-sealing compound can be used on titanium, stainless steel, steel, aluminum and h-t alloys at temperatures up to 400 F. (3) A high-purity version, said to be impervious to moisture, high voltage and cyclic thermal stress, is designed to prevent product contamination. — Crawford Fitting Company

88 **Plastic lube jar** with applicator brush should solve dirt-contamination problems when lubricating mechanical parts. A protected well in center of jar stores brush, keeping it free from contaminants when cap is on. Oil-resistant jar holds extreme-pressure lube in ring section surrounding well.—The Alpha-Molykote Corp

• Lubrication design aids:

Just circle key numbers on the Reader Service card, page 207, to get complete product story

476 **Lubricating-oil spray** for preventing rust is topic of 2-p data sheet. Mitchell Chemical Co, Inc

477 **Oil-mist-lubricating system** for single- and multiple-point spraying is covered in report 24. Oil-Rite Corporation

478 **Centralized lube systems** are detailed in 24-p booklet 26-T. Principles of operation, system components are discussed, illustrations of typical applications included. Eaton Manufacturing Company, Farval Div

479 **Bottle oilers,** oil cups and constant-level controls are detailed in 4-p circular 580. Lunkenheimer Co

480 **Lubricating equipment** for handling many jobs is covered in catalog X-135. Oil-Rite Corporation

For more facts circle 908 on Reader Service card, p 207

Begins on page 253

481 **Portable oil-testing kit** is subject of new bulletins. Kit is for maintenance of gasoline, diesel and gas engines. Lengor, Inc

482 **Lube labels,** all-vinyl self-sticking type for standardized identification of lubrication points are featured in data sheet 510B. W H Brady Company

483 **Portable and hand tachometers** are featured in 2-p bulletin. The Electro-Mechano Co

484 **Gear and bearing lubricants** are described, performance and characteristics covered in 8-p brochure. Lubrication Engineers, Inc

485 **Lubricant** for use at high temperatures, discussion of problems involved in assembly and run-in operations are featured in new literature. Acheson Colloids Company

486 **Solid-film lubrication** and protective-coating process is described in 4-p brochure. The Almasol Corporation

Just circle key numbers on the Reader Service card, page 207, to get complete product story

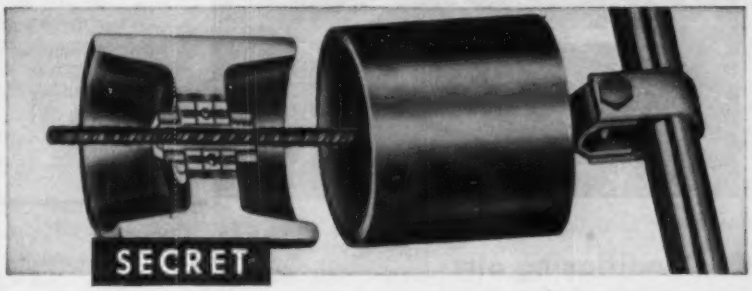
Coming events

Oct 6-8—National Association of Corrosion Engineers, Southeast Region Conference, Dinkler-Plaza Hotel, Atlanta, Georgia. Details: T J Hull, 1061 M&M Building, Houston 2, Texas.

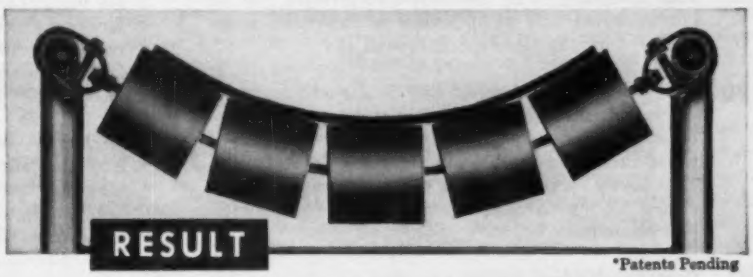
Oct. 10-11—American Institute of Mining, Metallurgical and Petroleum Engineers, Solid Fuels Conference, Daniel Boone Hotel, Charleston, W. Va. Details: AIME, 29 W 39th St, New York 18, N. Y.

Oct 11-14—National Association of Corrosion Engineers, Northeast Region Conference, Prichard Hotel, Huntington, W. Va. Details: T J Hull, 1061 M&M Building, Houston 2, Texas.

NEW (EXCLUSIVE WITH McNALLY PITTSBURG) CONVEYOR DESIGN ... slashes maintenance cost! ... extends belt life!



... of the amazingly improved efficiency of this modern belt conveyor is shown here. This new McNally Pittsburg Cradle Idler* consists of 5″ rubber rollers assembled on precision ground ball bearings, prelubricated and lifetime sealed. Being a *true catenary* suspension with rollers mounted on flexible, *non-rotating* stainless steel wire rope, this design eliminates "loping" and dangerous harmonics.



*Patents Pending

... is greater capacity and faster belt operation with minimum spillage. Since the belt lies in true arc with no creases or bends to cause wear, *belt life is substantially increased.* Because this McNally Pittsburg conveyor design is so simple, costs are lower, and erection time is reduced.

WRITE TODAY for details on the new conveyor which costs less to install ... *saves money every day it is in use.*

McNALLY · PITTSBURG

McNally Pittsburg Mfg. Corp.
Dept. PO, Pittsburg, Kansas

☐ Please send information on the new McNally Pittsburg belt conveyor.

☐ Have Sales Engineer call for further consultation.

Name_____ Title_____

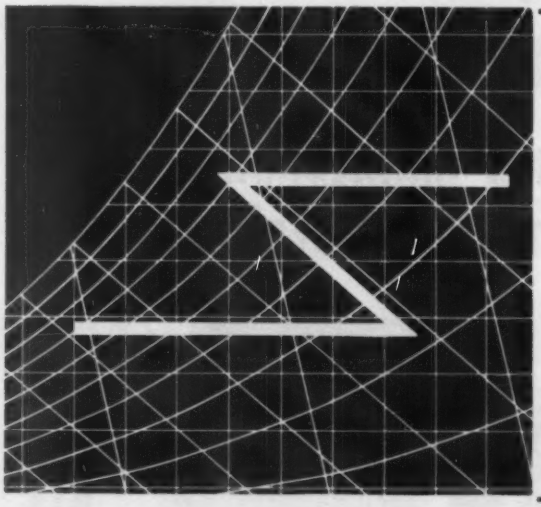
Company_____

Address_____

City_____ State_____

For more facts circle 909 on Reader Service card, p 207

AIR-CONDITIONING SYSTEMS



Current trend for industrial-plant air conditioning has created demand for both large central-system units and packaged spot-cooling equipment.

Maximum size of individual units continues to increase. Recent innovations in packaging of large central units resulted in extremely compact designs for compressor and absorption systems.

Clean air for industrial plants involved in precise manufacturing or assembling calls for highly efficient filtering and collecting units. Recent developments in this field aim for lower air-flow resistance combined with higher cleaning efficiency. Some of the equipment just coming out represents a large step forward.

L. E. Stewart

Associate Editor

● Conditioning air:

For full details use Reader Service card, p 207

89 **Packaged air conditioners** come in 25-, 30- and 40-ton sizes, with nominal air-holding capacities of 10,200, 12,600 and 17,000 cfm. Single-zone or multizone units feature quiet operation. Cabinet has a structural-steel frame with zinc-coated and phosphatized-steel panels. Fans are arranged for blow-through operation. On the control panel only on-off switch is externally accessible.—American-Standard Industrial Div

90 **Low-silhouette condensing unit** is a water saver for air conditioners. Blower condenser is standard; motor compressor, liquid receiver, electrical controls and refrigeration accessories can be remotely controlled. Unit comes in 10- to 30-ton sizes with enclosures designed for outdoor use, low noise, easy maintenance. —Dunham-Bush, Inc

91 **Centrifugal water chillers** fill any air-conditioning or process-cooling requirement, says manufacturer. Integral-fabricated water boxes give higher impact strength, improved connection flexibility and less leakage. Adaptable as heat pumps, units chill water down to 40 F.—The Trane Company

92 **Heater-bank assembly,** oven type, handles air-conditioning-duct work. Assembly provides high-capacity low-watt-density heat exchange, with fast heatup, minimum air-flow restriction. Flat-plate heaters mount in tandem. Banks connect for single- or 3-phase, 208-, 220- or 440-v service.—Electric Heater Specialty Co

● Ventilation and filtration

93 **Fiber-glass duct fans** come in sizes from 12 to 36 in., offer good resistance to corrosion. Propeller, dust section, drive housing and bearing cover are fiber glass, drive shaft and hardware are stainless steel.—Hartzell Propeller Fan Company

94 **Propeller type fan** replaces several smaller fan units in moving large volumes of air, increasing efficiency and economy, says maker. Unit has 65- to 94-in. belt-drive, direct-drive or pulley-drive construction. The 94-in. 25-hp model moves 174,000-cfm free air. Hubs and blades are aluminum alloy castings. — Hartzell Propeller Fan Company

95 **Dust collector** was developed for air-pollution problems arising from h-t fume and dust emissions. Glass fabric permits filtration at temperatures up to 550 F. Jet inside each filter tube cleans dust off inside surfaces by giving off higher-pressure air alternated with reverse air flow from main fan. Tubes partially collapse, cleaning filter surfaces, and residue is deposited in hoppers.—Pangborn Corporation

96 **Mechanical dust collector** designed for efficient collection of abrasive or heavy dust loadings can be arranged to handle almost any size job. Involute unit collects catalyst dust suspended in reactor effluent and regenerator flue gases. Hooked up to 24-in. steel-mesh-liner collector and electrostatic precipitator, it removes even very fine residual catalyst particles. Steel-mesh liners incorporated with castable cements are available for highly abrasive dusts.—Research-Cottrell, Inc

97 **Designed like a turbine,** axial-flow blower develops high pressure—up to 25-in. H_2O from a 4-in.dia rotor. Unit size can be cut in half in some applications, maker states. Design uses thin, highly curved blades. Reduced blade height along air passages helps control pressure gradients.—General Turbine Corporation

98 **Porcelainized blower wheels** are designed for process and air-conditioning equipment, cooling towers, evaporative condensers and other applications where corrosion or abrasion may exist. Only minor traces of rust were left on wheel blade after 1000-hr salt-spray test —most of these spots wiped off. Sizes of glass-coated wheels: from 10 to 20 in.—Morrison Products, Inc

99 **Fan sets** are for supply or exhaust jobs indoors or outdoors. They operate for volumes of 25,000 cfm, static pressures through 2½ in. and temperatures to 300 F, feature motor and drive integrated in one assembly. Entire drive is within the frame. Motor, drive

and bearings are completely accessible; motor and drive adjustment is easier; there's good motor ventilation.—Clarage Fan Co

100 **Direct-drive utility blowers** are made of unplasticized rigid polyvinyl chloride. This material resists corrosion from almost all types and combinations of fumes—blowers were designed to work where corrosion fumes or moisture are a problem. Units are available with 1/3-, ¾- or 1-hp motor and in capacities from 399 to 2000 cfm.—Industrial Plastic Fabricators, Inc

101 **Sampler speeds dust surveys.** It weighs nine lb, samples air at two cfm, filling need for lightweight, portable unit with high capacity. Centrifugal carbon-vane pump requires no lube; built-in fan and louvered metal case provide air circulation to keep pump cool. Sampler has open filter holder which connects to pump by polyethylene press-fit coupling. It's primarily for survey work where it will be used for an 8-hr working day.—Gelman Instrument Company

102 **Portable battery-operated sampler** frees user from power lines and line cord. Air pump, batteries, flowmeter, filter holder and battery charger are all contained in a durable shoulder bag. Complete unit weighs 14 lb.—Gelman Instrument Company

103 **Volume fabric dust collection** at low cost is feature of this unit. It is adaptable to any application where dry materials must be reclaimed. Operation is simple: dust-laden air enters inlet plenum at top, then 9-in.-dia filter bags through inlets.—American Air Filter Co, Inc

104 **Cloth dust collector** with centrifugal action, rotating blow tube, roller-support system features high air-cloth ratio and reduced space requirements. Small, medium and large sizes are available.—Dustex Corp

105 **Oil-bath air filter** has no moving parts. Pneumatic lift is a simplified method of lifting oil from the reservoir to perforated distribution plate which relays oil to the pads. There's no motor lube, brush replacement or circulation wear.—American Air Filter Co, Inc

106 **Modules** for separating entrained liquids from corrosive gas streams are designed for high collection efficiency, low pressure drop. They're made of corrosion-resistant graphite, operate on principle of impingement, come in two styles—single-row entrainment or with gutter and downcomer. Staggering prevents straight-through flow.—Union Carbide Corporation

107 **"Cube"-constructed replacement filter** claims service life at least six times longer than throw-away and permanent metal type filters. According to maker, unit combines high efficiency with low pressure drop even after it has collected several lb of dirt. Filtering action uses Dynel Modacrylic filtering medium, filter batt and open-side-cube construction. Air stream carbatt and open-side-cube construction.—Union Carbide Development Company, Inc

108 **Deep-pleat filter** operates at low pressure drop, provides high efficiency and dirt-holding capacity. Compact folding-filter cartridges are interchangeable. Series HP includes three atmospheric efficiency ranges —85, 95 and 35%. Folding media consists of reinforced material of fine glass fibers for high-range units and cotton for the lower-range unit.—Farr Company

109 **H-v electronic air cleaner** works on principle of electrostatic precipitation. Dust particles are charged as they enter unit, then attracted to and held by the negatively charged collector plates. Construction features ionizing and collecting chambers in one compact unit.—Dollinger Corporation

110 **Static generator** powers dust-shattering air-cleaning system. Compact unit provides h-v static electricity for 10,000-cfm air flow. It's made especially for Stratonic system of dirt and dust control. Generator supplies screens with energy necessary to bombard dirt and dust particles in air, exploding them into bits well below 0.1 micron—a size so small particles stay suspended. Weight is 30 lb.—CRS Industries, Inc

111 **Portable pressure blowers** were designed for ventilating—they remove fumes and dust, furnish fresh air for confined work areas—or supplying air under static pressure to boilers. They're waterproof and vaporproof. Thermally protected ¼-hp motor is totally enclosed.—Maintenance Co

112 **Sampler** operates at 100 cfm, collects dusts and aerosols on special filters. Filters can be analyzed to determine concentration of radioactive particles, toxic metals, dust contaminants and air pollutants. A 0.5-hp motor-driven turbine powers sampler. Unit weighs 9 lb complete with sampling head and operates at rates up to 100 cfm.—Gelman Instrument Company

113 **Portable air sampler** records dust or gas concentrations by sucking air through a paper tape. Treated papers change colors to measure gases, a densitometer measures dust and a Geiger counter tests for radioactive dust. Unit collects up to 900 samples at 1.5 to 36 cu ft of air per sample, weighs 21 lb. Industrial hygiene, air pollution, nuclear measurements are applications.—Gelman Instrument Company

Air-conditioning design aids: Circle numbers on Reader Service card, page 207

487 **Gas-fired heaters,** furnaces and packaged blowers are discussed in 28-p general catalog SA-5900. Specs, dimensional and performance data aid selection. Reznor Mfg Company

488 **Profitable investment** in factory air conditioning is topic of booklet prepared by Carrier Corp

489 **Air-conditioning equipment** is featured in 24-p catalog of firm's complete line. Catalog B-5529 also includes air-handling equipment, fluid drives, heat exchangers. American-Standard Industrial Div

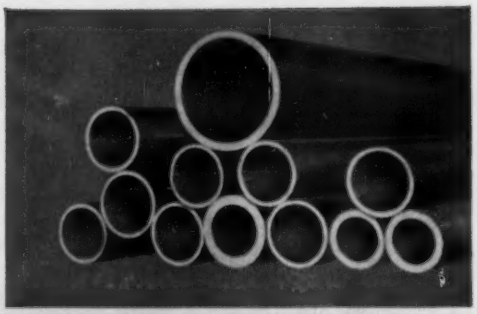
490 **Heating units** with 800-, 1000- and 1250-Btu output are covered in three new-product spec sheets. Includes dimensional drawings, illustrations of floor-mounted and horizontally suspended units. Wanson Corporation

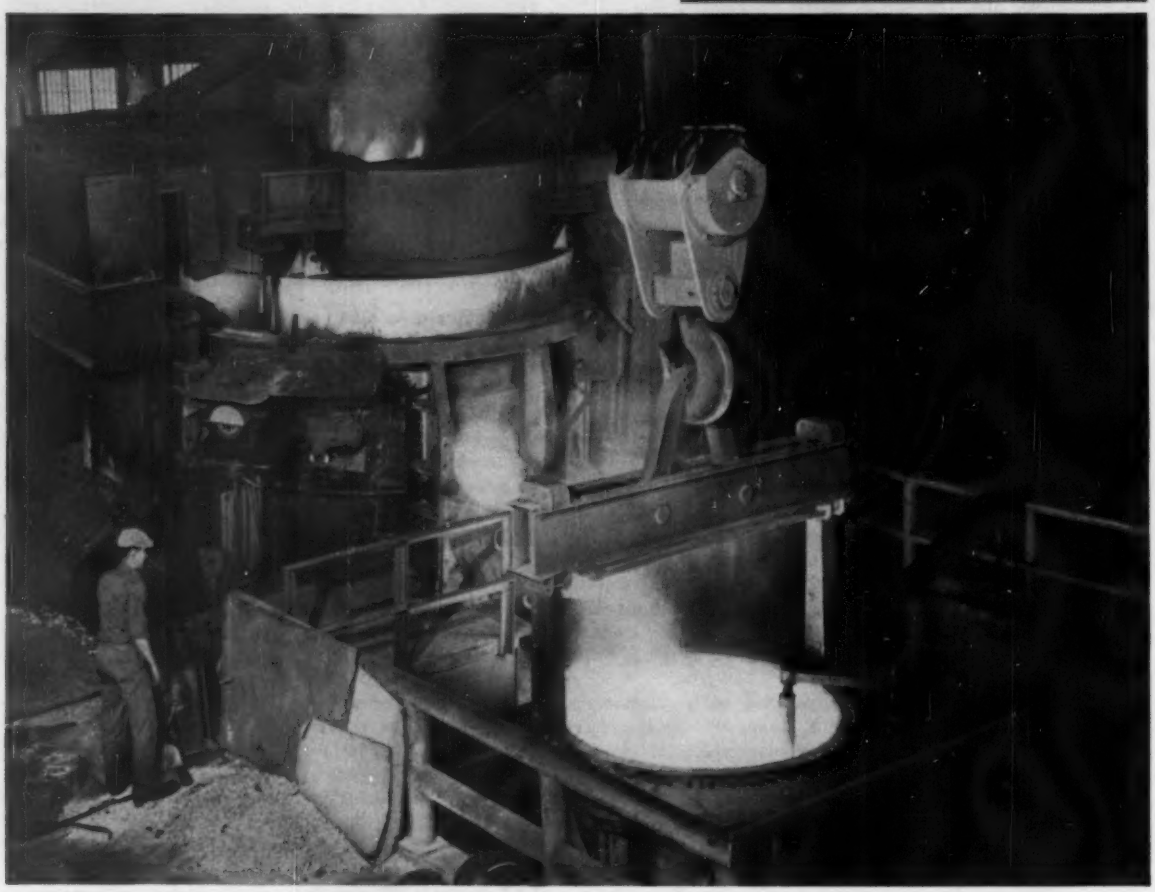
491 **Engineer's manual** on steam and water service guides selection of automatic heating and cooling controls. Examples for solving control problems are included. The Powers Regulator Company

492 **Perimeter** air conditioning of multiroom buildings is discussed in 8-p bulletin 9127. Installation drawings, tables provide dimensional data. American-Standard Industrial Div

continued

WHAT DO YOU LOOK FOR IN FORGED HEAVY WALL PIPE?





QUALITY?

B&W assures you of that, starting with control of the initial electric furnace melting of the specified analysis. No one gives its pipe more quality control tests—both in number and extensiveness—than B&W. At B&W, for example, even ultrasonic tests are *standard* practices, at no extra cost to you. Another good reason why B&W quality exceeds ASTM standards.

What's more, B&W Forged Heavy Wall Pipe comes in a wide range of sizes and grades to meet your design requirements. Delivery is prompt and dependable. Write for informative Bulletin S-16. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B-483-HP

B&W THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

For more facts circle 910 on Reader Service card, p 207

PILOT-OPERATED PRESSURE REDUCING VALVES

For Steam, Oil, Gas, Air, Water

	Max. Inlet Pressure (psi)	Max. Temp. °F	Outlet Spring Pressure Ranges (psi)
Bronze Body	300	475	½-15*, 10-75, 25-175, 100-250
Cast Iron Body	250	450	½-15*, 10-75, 25-175, 100-250
Steel Body	150	500	½-15*, 10-75, 25-175
	300	750	½-15*, 10-75, 25-175, 100-250
	400	750	10-75, 25-175, 100-250, 200-320
	600	750	10-75, 25-175, 100-250, 200-450
	900	750	10-75, 25-175, 100-250, 200-450

* Optional, With Low Pressure Top
Valves for 1500 psi working pressure available.

CHECK THESE FEATURES FOR YOURSELF

- ☐ Stellited main and pilot valve discs and seats
- ☐ Easily disassembled and serviced without removal from line
- ☐ Main and pilot valves protected by built-in strainers
- ☐ No stuffing boxes or bellows
- ☐ Main valve guide seat integrally cast with seat ring or aligned body bushing
- ☐ Available with screwed or flanged ends
- ☐ Single seat, tight closure for dead-end service
- ☐ Reduced pressure holds constant
- ☐ Full valve lift provides maximum capacity
- ☐ Self-contained. Needs no external pilot line or piping except for very low reductions
- ☐ Handwheel for easy adjustment

SEND FOR BULLETIN 659

ATLAS VALVE CO.
280 South Street
Newark 5, N. J.
Mitchell 2-2464

circle 911 on Reader Service card, p 207

Air conditioning

Begins on page 256

493 **Multizone** air conditioners are described in 4-p bulletin 8625. Drawings illustrate arrangements, location of basic elements. American-Standard Industrial Div

494 **Multizone air conditioners** are announced with engineering data, dimensions, specs in revised catalog 55c9a. Recold Corporation

495 **Air - conditioning,** heating and ventilating equipment, firm's new lines, are covered in 8-p bulletin. The Trane Company

496 **Vertical and horizontal** air-conditioning units are announced in catalog 54c9c. Specs, dimensions, arrangements and installation instructions for units rated 1200 to 34,800 cfm are included. Recold Corporation

497 **Air conditioning** and refrigeration are featured in 34-p bulletin 80-F. Related components, operating principles are covered. Frick Company

498 **Centrifugal-fan cooling towers** in 5- to 30-ton sizes for vertical or horizontal air flow are topic of 4-p specification. Halstead & Mitchell Co

499 **Aquatowers,** double-flow type for operational load and wind pressures of 30 psf, have specs, engineering data listed in 4-p bulletin. The Marley Company

500 **Water treatment** for cooling towers and evaporative condensers in small a-c systems is discussed in bulletin 7; 1-package treatment is introduced. Metropolitan Refining Co, Inc

501 **High-hp speed reducers** for cooling towers are featured in bulletin 135-S. The Cleveland Worm and Gear Company

502 **Chemical control** for feeding balanced chemical treatment into circulating-water systems of cooling towers and evaporative condensers is introduced in folder. Erlen Products Company

503 **Cooling towers** are covered in 4-p bulletin KT-104. Construction, performance details and specs included. American Air Filter Company, Inc

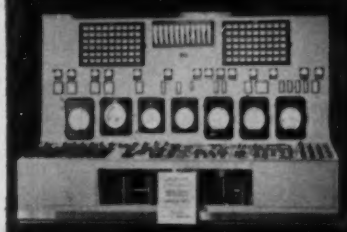
• Ventilation, filtration

504 **Portable ventilators,** man-cooling fans are topic of catalog 180. Discusses most profitable ways to use air. Coppus Engineering Corporation

505 **Industrial fans** are presented in 28-p bulletin L-5. Includes rating tables giving volumes of delivered air, rpm, hp at various static pressures, outlet velocity

WHAT COMES UNDER

ENERGY CONTROL?



On paper it's just a phrase, but at work with you and your company it's important. Everything from fuel savings to calculating nuclear fuel costs comes under the heading of "energy control"—a subject of profit to you and your company.

Constant changes in the field make it imperative that you see such exhibits at the Power Show as temperature controllers, pressure and draft controls, liquid heat controllers and many others —PLUS a broad line of other power and allied equipment.

Only at the Power Show do you have the opportunity to investigate, compare and get the right answers, face-to-face, from the manufacturers themselves. Only at the Power Show can you see over 250 leading suppliers' products, all conveniently grouped together at one time.

Make sure you're there. Everyone else will be!

2523

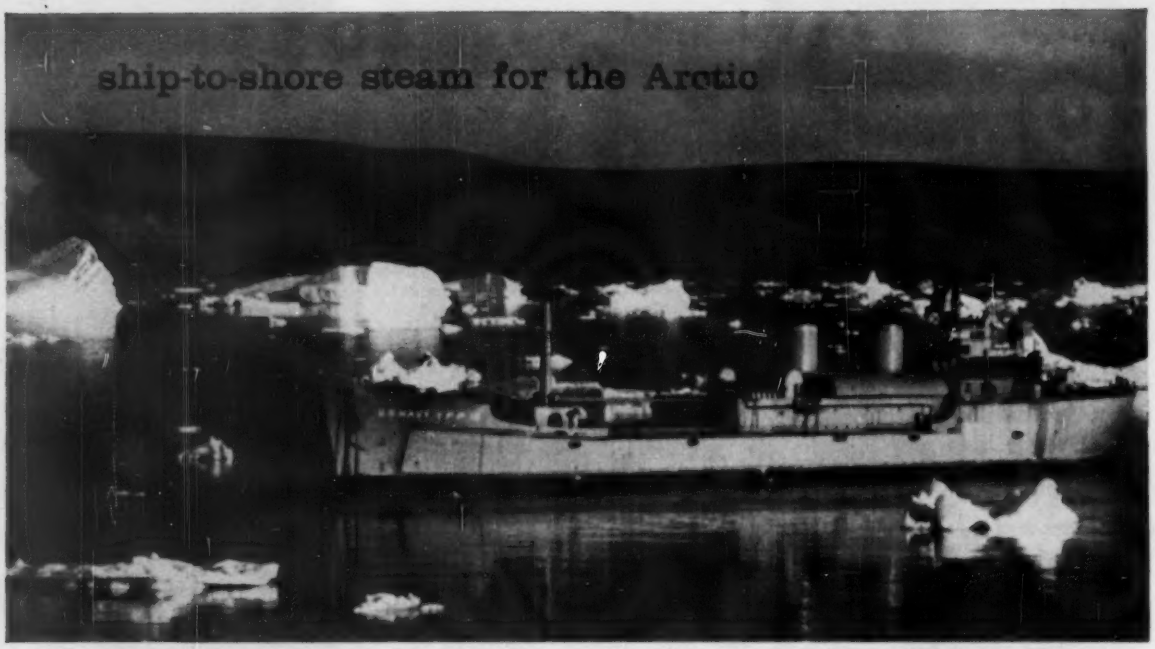
24th NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING

AUSPICES ASME

NEW YORK COLISEUM
NOV. 28—DEC. 2, 1960

MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY
480 Lexington Ave., New York 17, N. Y.

circle 912 on Reader Service card, p 207



CO-OPERATION — U.S. Army Engineers' Eastern Ocean District converted this Navy Floating Power Plant for the Arctic. Contractor — Bethlehem Steel Co.; consulting engineers — Metcalf and Eddy; and Reynolds, Smith and Hills. Military Sea Transportation Service towed it to northern Greenland where it will serve as part of the Ballistic Missile Early Warning System. (Photo credit, U.S. Navy)

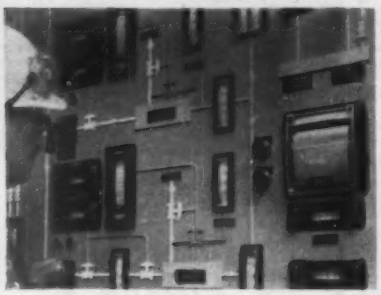
Foxboro controls "export" steam for unique Air Force floating power plant

A seagoing cargo vessel converted to a modern, shore-type steam-electric power plant. That's the YFP-10, designed for the Air Force — and floated to a site off northern Greenland where it will produce steam and power for the Ballistic Missile Early Warning System.

The YFP-10 can produce up to 135,000 pounds of export steam per hour. All steam temperature and pressure variables are under Foxboro control. Consotrol* control stations on the panel — Foxboro indicating pressure and temperature transmitters, and Foxboro valves on the line. Accurate, dependable, low-maintenance instruments — ideal for applications where top performance is critical.

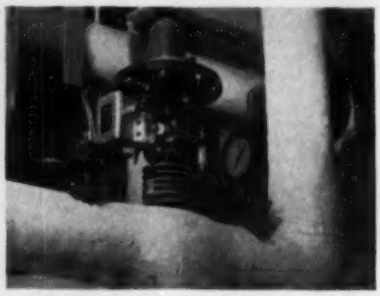
Afloat or ashore, nuclear or conventional — there's advanced Foxboro instrumentation for any power plant. Ask your nearby Foxboro Field Engineer for full details. Or write The Foxboro Company, 6810 Neponset Ave., Foxboro, Mass.

*Reg. U.S. Pat. Off.



Foxboro Graphic Panel controls pressures and temperatures of steam "exported" from YFP-10. Instrument at right is Consotrol Recorder with Controller integrally mounted at rear. Complete control station pulls out like a drawer, making all adjustments and component parts easily accessible.

Foxboro M/44 Transmitters monitor both export steam temperatures and pressures aboard the YFP-10. Direct-connected, 4-inch indicators continue to give measurements even in event of instrument air failure.



Final operators on the YFP-10's export steam system are all Foxboro valves equipped with high-speed: super-response Vernier Valvactors*. Valvactors eliminate any problem of stem or plug friction, valve motor or transmission line lag.

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For more facts circle 913 on Reader Service card, p 207

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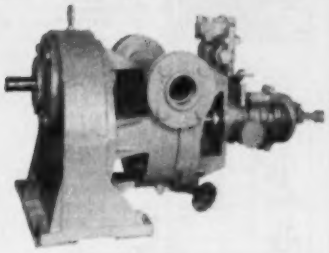

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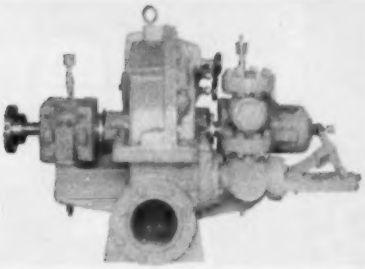
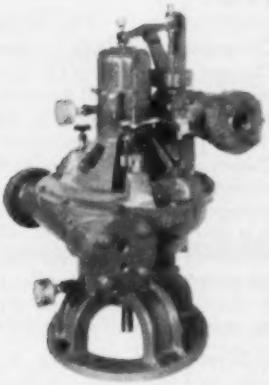


in TURBINES



WRITE FOR BULLETIN 20—C-3

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Representatives in Principal Cities

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Air conditioning

Begins on page 256

and velocity pressures. Fuller Co, Lehigh Fan & Blower Div

506 **Induced - draft fans,** industrial fans are rated with specifications, outline dimensions in bulletins L-3, L-5. Fuller Company, Lehigh Fan & Blower Div

507 **Propeller fans** are covered in 18-p bulletin A-109E, plus info on materials and coatings. Hartzell Propeller Fan Company

508 **All-purpose centrifugal fans** are topic of 76-p catalog describing complete line. Key components and features are well illustrated; performance data and dimensions included. Westinghouse Electric Corporation, Sturtevant Div

509 **Ventilating equipment,** corrosion-resistant type with options in materials: topic of 4-p booklet 1117. Hartzell Propeller Fan Co

510 **Ventilating and heating** units are presented in 24-p catalog available from McQuay, Inc

511 **Gas scrubbers and cyclones** are covered in 12-p bulletin 4R. Application, construction, operation info given. Schutte & Koerting Co

512 **Mechanical dust collectors** and recent improvements including new involute design are covered in 8-p bulletin 300. Research-Cottrell, Inc

513 **Dust collectors** are discussed, list of typical industrial applications is included in bulletin 1828. American-Standard Industrial Div

514 **Reverse-jet** dust collector with fabric filter bags eliminates rubber-hose wear. Bulletin 279C tells story. American Air Filter Co, Inc

515 **Exhaust purifiers** for oxidizing CO, fumes and odors from gasoline, l-p gas and diesel-powered equipment are covered in 4-p folder. Oxy-Catalyst, Inc

516 **Centrifugal airfoil-bladed fans** are described in 60-p bulletin A-1103. Applications, modifications, specs are given. American-Standard Industrial Div

517 **Dust-topics pamphlet** discusses methods of collecting and measuring aerosols and dusts from ducts and stacks. Gelman Instrument Company

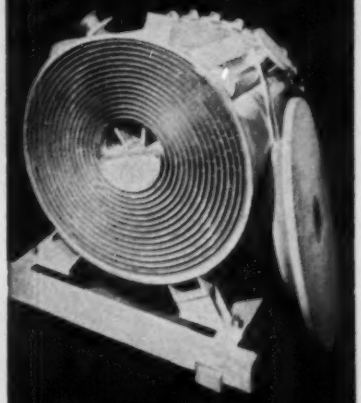
518 **Tubeaxial blowers** for ventilation of large tanks, other confined areas are topic of data sheet 134. Corpus Engineering Corporation

519 **High-energy** dust-fume scrubber featuring small size, efficiency even in submicron range is covered in 4-p bulletin W-8560. The Ducon Co

520 **Dirt and dust control** by electronic particulate bombardment

TO BE "HOT" ON

HEAT TRANSFER



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NOV. 28—DEC. 2, 1960

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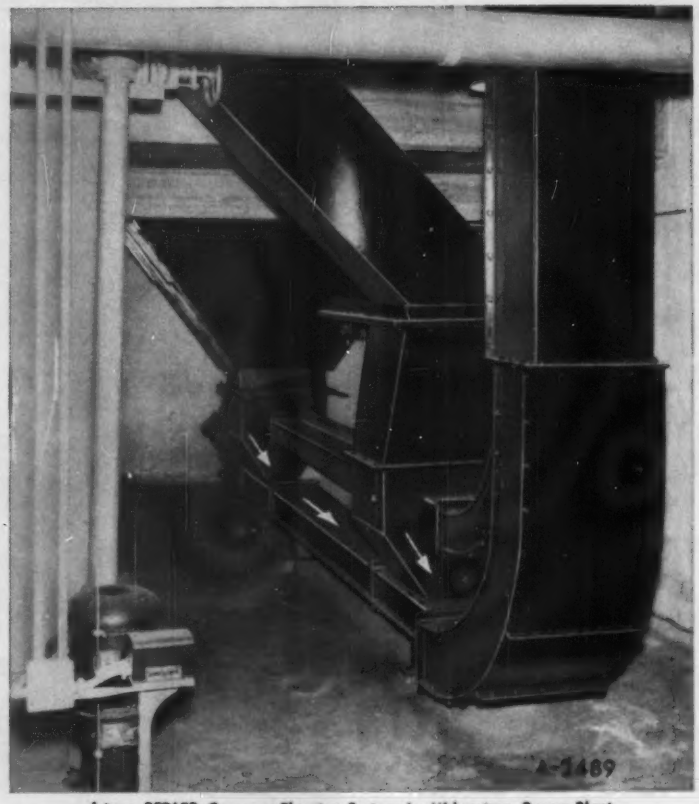
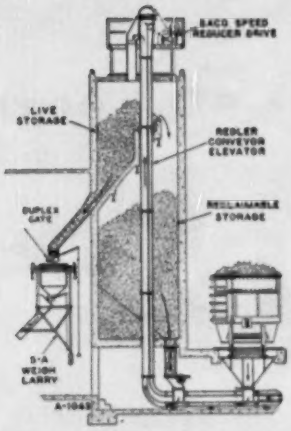
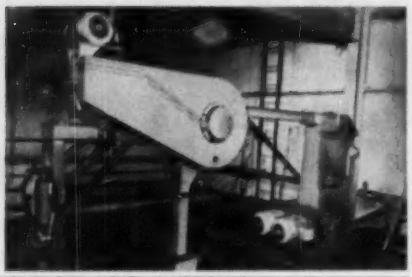
STEPHENS-ADAMSON



L-type REDLER Conveyor-Elevator System in Midwestern Power Plant

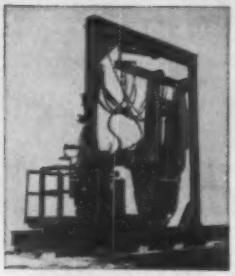


Drawing above illustrates flow of coal through a typical REDLER Conveyor-Elevator installation.



Vertical Closed-Circuit REDLER Elevator discharges coal into double-roll Knittel Sampling Crusher. Coal "cut" from main flow is sampled for B.T.U. content.

REDLER® Conveyor-Elevator INCREASES EFFICIENCY ...LOWERS COST IN COAL HANDLING!



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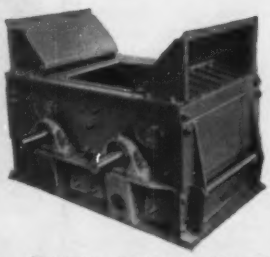

S-A RING TYPE DOUBLE ROTOR KNITTEL CRUSHER — Crushes lumps while in suspension . . . no breaker plates needed. Maintains full capacity with wet coal — no clogging. Greater capacity—less space required.

STEPHENS-ADAMSON engineered REDLER Conveyor-Elevator Systems backed by over a half century of coal handling "Know-how" provide dependable coal handling service at the lowest cost-per-ton figured over the life of the equipment. In the Midwestern installation shown above, an L-type REDLER Conveyor-Elevator System handles distribution from an unloading hopper to a storage silo and from reclaimable storage to live storage shelf or direct to boiler room. Dust is confined within the sealed REDLER casings thereby contributing to good housekeeping. S-A REDLER coal handling systems save space, offer flexibility in application and often combine both conveying and elevating operations usually with only one drive.

REDLER Conveyor-Elevators are available in sizes to handle practically any tonnage. They can be designed to fit into any new or existing structure and will occupy a minimum of space.

WRITE FOR BULLETINS 358, 858 and 658

S-A
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Air conditioning

Begins on page 256

and negative ionization — described in folder. CRS Industries, Inc

521 **Dry dust-control equipment** is featured in 28-p catalog 805. Shows ways of using cloth filtration and cyclonic equipment to eliminate dust-control and a-p problems. Fuller Company, Dracco Div

522 **Electronic air cleaner** is topic of 12-p bulletin 405. Diagrams, photos and specs are given. Dollinger Corp

523 **Glass-bag filters** to end hot, corrosive dust headaches are topic of 12-p bulletin 806. Bag cleaning is described. Fuller Company, Dracco Div

524 **Unit air filters,** permanent and washable type, are discussed in 12-p bulletin 207. Explanations of filter maintenance methods and equipment are given. American Air Filter Company, Inc

525 **Carbon-odor filter** for air cleaning is described in 4-p bulletin 220. Gives engineering data on filter's initial resistance. American Air Filter Company, Inc

526 **Filters and filter elements** are described in 4-p bulletin M-213A. Lists stock and nonstock filters and elements. Pall Corporation, Micro Metallic Div

527 **Instrument system** for automatic operation and control of filter plants with 3- to 15-psi output pressures is discussed in brochure 1100C. Infilco Inc

• Refrigeration

528 **Direct and indirect coolers** and dryers, electrical and mechanical vibrating types, are featured in 32-p catalog 958. Discussion includes info on auxiliary equipment in vibrating line. The Jeffrey Mfg Company

529 **Air-cooling units** are topic of 12-p bulletin 500. Includes tables of dimensions. Frick Company

530 **Refrigeration systems** in modern gasoline plants—topic of 8-p bulletin 172. Clark Bros Company

531 **Refrigeration-system purging** is covered in 12-p bulletin 700. Armstrong Machine Works

532 **Refrigeration** and air-conditioning valves, heat exchangers, components are topic of 20-p catalog R-7. Superior Valve & Fittings Company

533 **Thermostatic expansion valves,** regulators, controls for refrigeration are topic of 12-p catalog 59A. Sporlan Valve Company

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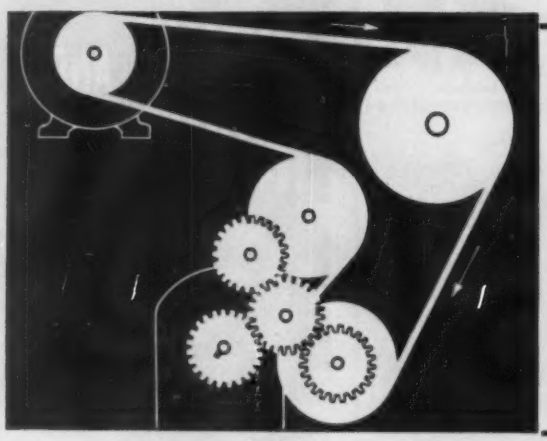
MECHANICAL-TRANSMISSION SYSTEMS



A mechanical-power truism often overlooked is that all horsepower delivered by an electric motor or prime mover is carried through some piece of mechanical transmission equipment. With loads getting tougher, with demands for adjustable speed climbing, with a growing emphasis on compact, trouble-free design, equipment makers have been hard at work developing products that will successfully mate driver output to load needs. Results of these efforts are listed on following pages.

Managing Editor

● Adjustable drives, reducers:

Circle key numbers on Reader Service card, p 207

114 **Stepless adjustable-speed drive** is offered as a complete package. It includes drive unit, control enclosure with control for both coupling and integrally mounted ac motor, operator's station. Wide speed range includes ratings through 20 hp with capacity for continuous operation down to 100 rpm at rated torque providing a speed range of approximately 17:1. Eddy-current coupling units have bearings arranged for positive gap alignment and to simplify disassembly and reassembly. Coupling field coil and tachometer generator are stationary, with no brushes or slip rings. Windings are encapsulated in epoxy resin for positive protection.—General Electric Company

115 **Brushless** adjustable ac speed drives have integral-unit construction, are rated ¼ to 100 hp. Larger drives with bedplate-mounted motor are offered up to 700 hp, liquid cooled. Drive supplies power to conveyors, fans and pumps, winders—any application where speed control is needed. There are no brushes, commutators or slip rings.—Westinghouse Electric Corporation

116 **Variable-speed drive** features built-on motor. All-metal traction unit gives stepless control. It's compact, often can be adapted to existing machinery—offered in capacities from fractional to 16 hp.—Eaton Manufacturing Company, Cleveland Worm & Gear Div

117 **Fluid drives,** developed for use with on-the-shaft boiler-feed pump drive arrangements, are particularly good for heavy-duty requirements. According to maker, they provide adjustable speed control which saves power over entire operating range. Standard units are available for either 3600- or 1800-rpm operating input speed.—American Standard Industrial Div

118 **Hydraulic-transmission** 1½-hp unit has variable speed from 0 to 350 rpm in either direction. Forward and reverse speeds can be set identical or different. Reversing is instantaneous. Motor with rolling-contact bearings is available for either single- or 3-phase supply.—Roberts Manufacturing Company

119 **Gearing units** have output speed of 420 rpm—especially applicable in side-entry agitators, according to maker. Ratio of concentric shaft units is 4.17:1 producing output speed of about 420 rpm with 1750-rpm input.—Westinghouse Electric Corporation

120 **Worm-gear reducer** has fan-cooled design for saving space and weight while transmitting maximum loading on worm and gear, says maker. Gear material of centrifugally cast phosphor bronze shows mechanical strength, good wearing properties and low coefficient of friction. No connecting piping, circulating water and cooling coils in lower casing are needed. Top rise is 100 F above ambient. Fan provides motion of air—a factor in increasing heat dissipation in higher speed range. Units are available from 1/10 to 150 hp.—De Laval Steam Turbine Company

121 **Quadruple-reduction** helical speed reducers with precision-ground gearing feature minimum noise, vibration and backlash. Units are available in ratios of 106:1 to 650:1, rated 815 hp.—Philadelphia Gear Corp

122 **Higher-hp reducer** has 1-piece cast-iron housing for strength and heat dissipation. Cooling fan mounts on input end of worm shaft, rotates in either direction.—Cleveland Worm & Gear Co

123 **Heavy-duty limit switch** for travel speed applications as high as 1200 ft per min features forked operating lever of high-impact-resistant plastic. Material will not damage operating bar and its resilience reduces shock to interior parts. Switch works indoors and outdoors.—Square D Co, EC&M Div

124 **Flange type coupling** is for heavy-duty use on internal-combustion engines where coupling must be bolted directly to flywheel. Two metal bodies with interlocking jaws are separated by nonmetallic load cushions. Removable, individual inserts held in place by a steel collar provide easy inspection or replacement. No lubrication.—Gerbing Mfg Co

● Belts, pulleys, sheaves

125 **Notched V-belt** is said to have quiet, vibrationless running characteristics. Rugged and flexible, it runs smoothly over small pulleys. Fully molded and jacketed construction eliminates flex cracking, increases

fatigue resistance. Design feature is micro-positioned cord, formed into an arch through molding process for increased sidewall pressure providing more grip, little or no slippage and more-uniform pitch.—Raybestos-Manhattan, Inc, Manhattan Rubber Div

126 **All-synthetic transmission belting** has a "molecular memory" making it nearly stretch-free, manufacturer states. Nylon bands, especially oriented for extra strength, and woven nylon cloth are used. Pulley side is coated with urethane for high coefficient of friction. Belts resist humidity, oils, many acids; they're said to withstand 200 F.—L H Shingle Company

127 **Pulleys team up** to increase variable-speed flexibility. Dual variable-pitch pulleys are used on drives in ⅛- to 2-hp range, with ratios to 4:1. Belts connect a combination of one spring-loaded and one manually actuated pulley. Turning a wheel widens or narrows belt-seating groove of manual pulley to control operation of drive. This produces instant inverse change in pitch diameter of spring-loaded pulley. Sizes are 3½-, 4-, 5- and 6-in. OD.—Maurey Manufacturing Corporation

128 **Sliding motor base** of low pancake type is for variable-speed-sheave installations. Unit provides rapid release of adjusting screw. Height is only 1 21/32 in. Amount of movement is 4½ or 6 in. depending on motor frame.—T B Wood's Sons Co

129 **Shaft** transmits up to 1650 in.-lb torque at 500 rpm. Extra-heavy-duty power-drive flexible shafts are designed to transmit large amounts of rotary power over any curved path, says maker. Heavy-duty core is made up of layers of tightly wound music wire; casing is lined with oil-tempered spring steel reinforced with wire braid.—Stow Manufacturing Company

130 **Chain tightener** should reduce vibration, extend chain life while providing ample takeup. Units come in three stock sizes to fit standard chain.—Industrial Marketers

131 **Lubricant** in spray-on container is said to increase open-chain life 300%. It offers faster and easier application to conveyor and transmission chains of all types. Lube was developed to work into close-tolerance internal-friction surfaces of open chain between bushings and pins or bushings and rollers to reduce wear and dissipate heat. It features built-in corrosion inhibitor.—Whitmore Mfg Co

132 **Variable-speed sheave** holds a constant driven speed during changing torque loads. Sidewall pressure on belt varies to carry the load, so pitch diameter is maintained, driven speed is kept constant regardless of torque condition. Two sizes cover 7½ to 15 and 15 to 20 hp. This sheave boasts a special lubrication system to eliminate fretting corrosion and freezing.—T B Wood's Sons Co

● Bearings, gears, clutches

133 **Pillow-block bearings** feature narrow width. They use housings of ductile material, are designed for light and medium service. Eccentric locking collar secures inner bearing ring to shaft; set screw assures positive locking, says maker. Available in shaft sizes from ½ to 1 3/16 in.—Hoover Ball and Bearing Co

134 **Pillow blocks** permit easy liner replacement. You can replace bronze precision liners without removing bottom half of housing from its support. Simply remove block's cap, lift shaft just enough to loosen lower half of liner and slip it out. Insert and seat new bronze liner by slight tapping. Semisteel housings with tongue-and-groove joints or fitted bolts prevent shifting. Brass retainer spool recessed between cap and base of housing prevents liner rotation with shaft.—Dodge Mfg Corporation

135 **All-plastic bearing** can run dry, doesn't need lubricant, says maker. Low friction coefficient of surface plus inherent ability of material to withstand frictional heat reduce maintenance and lube cost.—Industrial Safety Supply Co, Inc, Industrial Plastic Supply Div

136 **Bevel gear boxes,** model BA-5, come in complete heavy-duty range. Shaft sizes are ⅛- to ¼-in. diameter with variable shaft outputs and inputs. You can have ball or oil-less bearings.—PIC Design Corp

137 **Heavy-duty direct-pressure clutches** with torque capacity from 200 to 1400 lb-ft feature high mechanical efficiency. Needle-bearing friction-free internal-lever-linkage system provides this efficiency.—Lipe-Rollway Corp, Clutch Div

138 **Sealed roller bearing** handles high-load applications in abrasive environments. Feature is buna-N steel-backed rubber-bonded seal said to prevent dirt, dust and chaff from abrading rollers and races. Sealed bearing has capacity of 13,400 lb.—Rollaway Bearing Company, Inc

139 **Nylon tubular bars** are now available for bearings. Reduced manufacturing costs make possible a 50% price cut for bars of MC-nylon formulation. Recommended for use as lubricated sleeve bearings at pressure-velocity values up to 50,000 in continuous service, 5000 as unlubricated bearings.—Polymer Corporation

● Mechanical-transmission system design aids: Reader Service card, p 207, brings details

534 **Speed reducers,** in-line and right-angle helical drives, are featured in 24-p booklet J-18. Rating tables, selection procedures included. Hewitt-Robins, Inc

535 **Shaft-mounted speed reducers** are described and illustrated in 24-p booklet J-19 which lists design features, includes application, dimensions and recommended part sizes. Hewitt-Robins, Inc

536 **Helical-gear speed reducers** in double, triple and quadruple reductions are featured in 20-p booklet 2751. Hp and torque, dimensions, mounting arrangements given. Link-Belt Company

537 **Shaft-mounted units** are described in 64-p bulletin A692. Reducers for flange mounting,

This maintenance engineer is "Seveneering" with R/M for his hydraulic packing needs

At the suggestion of his local R/M packing distributor, he is installing Big 7 Packing Type #7 (self-sealing, self-adjusting R/M Vee-Flex® rings) on the plunger of a freight-handling elevator. He will also use this R/M packing on his hydraulic rams, pumps, valves and accumulators. The unique design and construction of this packing will not only seal laterally against the stuffing box wall, but will also seal longitudinally against the next ring. This assures maximum sealing performance under any pressure without extrusion. And only a light gland adjustment is required to provide a positive seal.

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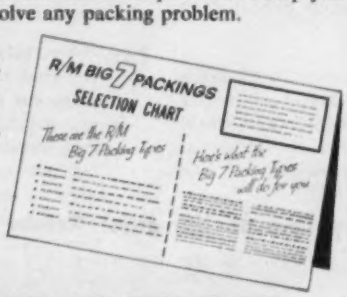

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MECHANICAL PACKINGS AND GASKET MATERIALS

Mechanical transmission

Begins on page 264

vertical shafts, right-angle and screw-conveyor drives included. Dodge Mfg Company

538 **Vertical motor reducers** and in-line reducers are topics of 28-p catalog Mr-58. Eight housing sizes cover applications to 125 hp, output speeds of 9 to 420 rpm. Philadelphia Gear Corporation

539 **Instrument drives,** flexible shafts, geared adapters are some equipment included in 12-p booklet from Actuator Products Corp

540 **Fluid drives,** adjustable-speed type, are covered in 20-p bulletin A-79. Principle of operation and applications described. American-Standard Industrial Div

541 **Gearmotors** from ¼ to 100 hp are described in 8-p bulletin 51B9172. Covers all motor types including right-angle and special designs. Allis Chalmers Manufacturing Company

542 **Speed drive,** mechanical adjustable, with range up to 8:1, ratings from 1 to 30 hp ac, is described in brochure 3600. The Louis Allis Co

543 **Timing-belt drives** are subject of catalog DTE-1. Selection, design, installation, operation and maintenance info is given. R & J Dick Company, Inc

544 **Gearbelt drives** are topic of 58-p bulletin. Info on installation, engineering, drive combinations and pulleys is included. Browning Manufacturing Company

545 **Roller chain** and sprocket line is detailed in 56-p booklet. Photos and diagrams show construction details. Selection data and price list are given. Dodge Manufacturing Company

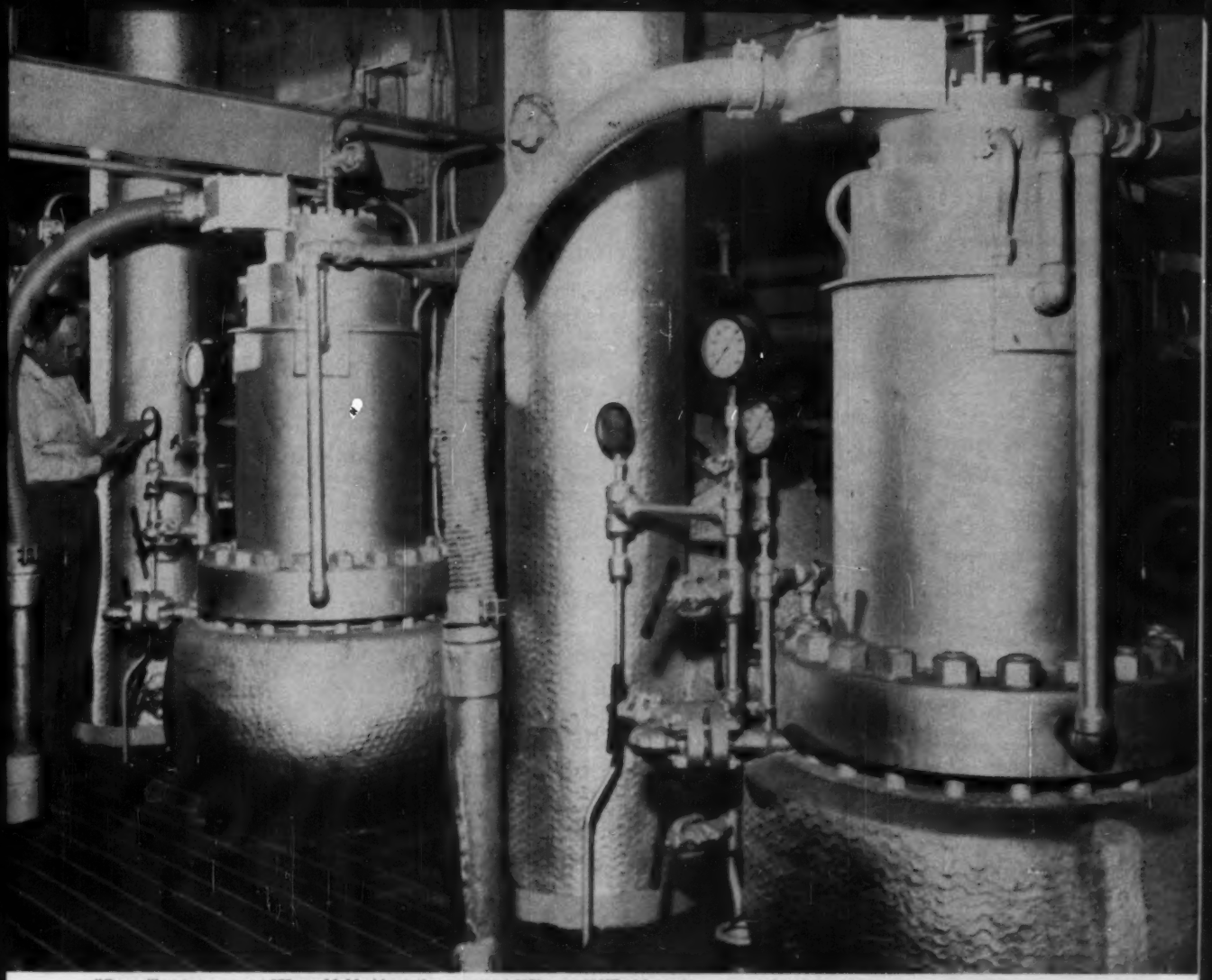
546 **Molded V-belts,** jacketed and notched, are covered in 4-p catalog M220. Raybestos-Manhattan, Inc, Manhattan Rubber Div

547 **Industrial V-belt-design** 64-p catalog features easy pre-engineered tables. Selection, hp ratings, product info included. Boston Woven Hose & Rubber Company

548 **Belt-selection guide** for variable-speed-belt users gives sizes and engineering data. 32-p catalog VSB-1 also supplies ratings and variable-speed cross-reference tables. Maurey Mfg Corp

549 **Chain drives** are topic of product bulletin 59126. Installation, operation, maintenance procedures given. Chain Belt Company

continued



"Canned" motor-pumps at 275-mw McMeekin station operate at 6270 gpm, 652°F with suction pressure of 2536 pounds.

Westinghouse canned motor-pumps help McMeekin station post nation's best heat rate

South Carolina Electric and Gas Company's Silas McMeekin station* recently recorded an annual heat rate of *9093 Btu* per net kwhr. This is the *number one* efficiency rating for the whole country in the Federal Power Commission's latest "Steam-Electric Plant Annual Production Expenses" report.

With two Combustion Engineering Controlled Circulation boilers furnishing the entire steam supply, the three Westinghouse "canned" motor-pumps installed on each boiler were important factors in this plant's exceptional efficiency rate.

- In operation since the second quarter of 1958, no pump has had to be opened for inspection or repair.
- The pump and motor casings completely enclose the pump shafting . . . eliminating conventional shaft seals and power-consuming seal injection systems.
- Watertight Inconel can encases stator . . . windings are dry and clean for years of trouble-free operation.
- Water lubricated bearings show maximum reliability and minimum wear characteristics.

To learn how Westinghouse "canned" motor-pumps will improve efficiency of *your* Controlled Circulation boiler, call your Westinghouse sales engineer, or write Westinghouse Electric Corporation, Atomic Equipment Department, P.O. Box 217, Cheswick, Pa. J-57023-R

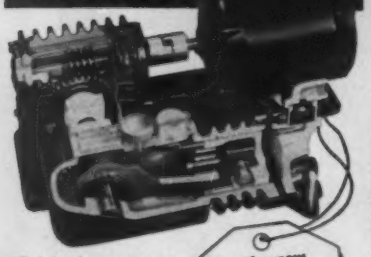
*Gilbert Associates, Consulting-Engineers

YOU CAN BE SURE...IF IT'S Westinghouse

For more facts circle 920 on Reader Service card, p 207

(Advertisement)

UNITIZED CONSTRUCTION MAKES THE BIG DIFFERENCE



in the new **MADDEN** *Metriflow* **METERING PUMP**

Unitized construction means it's completely enclosed, locked in permanent alignment, sealed against leakage, dirt and weather. All moving parts inside run in oil. Heavy duty design includes machine cut gears, outboard bearings on pump drive shaft. Solution heads of special materials available for slurries, corrosive liquids. Four standard sizes, up to 54 GPH, pressures to 300 psi. Duplex units provide twice the capacity with one motor.

Write for complete information on the new Madden METRIFLOW Metering Pump

The **MADDEN CORPORATION**
1345 Jarvis Ave. Chicago 26, Ill.

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FISH PROBLEM?????

The Burkey Electric Fish Screen is a modern method of fish control, consisting of an electrode system, energized by an Electronic Fish Control Unit. A *harmless* electrified zone of water is created—which keeps fish at a safe distance from screen wells and other intakes without stunning or killing them.

Typical users:
. . . Power Plants
. . . Refineries
. . . Industrial Pumping Installations
. . . Water Works

Equally effective in fresh or sea water. Data sheets, brochure, and preliminary sketches available at no cost to you. Each installation engineered to your specifications.

ELECTRIC FISH SCREEN CO.
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circle 922 on Reader Service card, p 207

ROBVON BACKING RINGS

ROBVON BACKING RINGS APPROVED FOR WELDING PIPE, VALVES AND FITTING JOINTS

Robvon's Commercial Backing Rings are designed for quick easy alignment of pipe or tubing and assure precise close tolerance fit-up. Robvon Backing Rings allow complete penetration and fusion of the weld. Robvon Backing Rings radiograph perfect certified welds. The patented nubs automatically set the welding gap for the root-pass. The internal bevel and flat inner lead assures non-restricted fluid flow.

ROBVON
BACKING RING COMPANY 675 *Garden Street, Elizabeth, N. J.*
Reg. Pat. Nos. 2,764,426 & 2,366,579 *Phone:* EL. 2-9613

For more facts circle 923 on Reader Service card, p 207

Mechanical transmission

Begins on page 264

550 **V-belt drive** cuts overall dimensions in half—details in 36-p booklet. Selection tables for stock and nonstock sheaves, hp, specs and installation instructions are given. T B Wood's Sons Company

551 **V-belt drive manual** has 68-pp, includes data for design of multiple-V drives with high hp rating. Uses new standard code designation system. Photos, drawings, chart, tables and other engineering data cover selection and design from ½ to 1000 hp. R & J Dick Company, Inc

552 **Variable-speed sheave** for standard V-belts with stationary control is detailed in 8-p bulletin 6102. Exploded view shows components. T B Wood's Sons Co

553 **Variable-speed sheaves** hold constant driven speed under varying torque loads—topic of 8-p bulletin 8102. T B Wood's Sons Co

554 **Pulleys, rollers, bearings,** bushings and guides are covered in data sheets. Lignum-Vitae Products Corporation

555 **Variable-speed pulleys** are topic of 24-p bulletin HL-60. Discusses operating principles and proper selection. Hi-Lo Manufacturing Co

556 **Spring-loaded pulleys** and adjustable motor bases are introduced in 4-p brochure 81-1. Maurey Mfg Corp

557 **Curve-crown pulley** with welded all-steel construction is announced in new-product bulletin 558. Stephens-Adamson Mfg Co

558 **Fretting-corrosion control** and ways to control corrosion in variable-speed sheaves are discussed in new bulletin 7102. T B Wood's Sons Company

559 **Motor reducer** for output speeds to 1 rpm, 75 hp is detailed in 4-p supplement 3100.01. The Falk Corporation

• Bearings, gears, clutches

560 **Cylindrical roller bearings** are discussed in 12-p bulletin 114. Gives dimension, load and application info. Hoover Ball and Bearing Company

561 **Ball bearings** with in. and metric dimensions are described in 4-p bulletin 112. Hoover Ball and Bearing Company

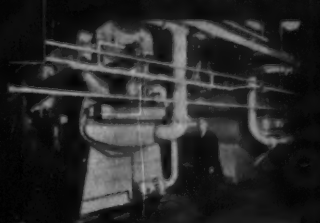
562 **Tapered-roller pillow blocks** are detailed in 4-p bulletin BU-

modern times . . .

photos courtesy Balthazar Korab

demand modern water treatment technology

Mr. Alfred C. Lamb, Director of Buildings Services, is shown with large absorption refrigeration system used in air-conditioning Wayne State University.



Illustrated evidence is the McGregor Memorial Building of Wayne State University, Detroit, Michigan. Wayne State University selected MOGUL WATER TREATMENTS to protect the water-using equipment serving this attractive and modern $1,172,000 addition to the extensive facilities of this nationally known university.

Thousands of colleges, schools, institutions, hospitals, public buildings and industrial plants of all types, nationwide, use MOGUL. In addition to fact-finding surveys, periodic inspections, consulting service, water analyses (all supplied without charge to MOGUL users), The North-American Mogul Products Company offers a complete water treatment program with performance results guaranteed.

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MOGUL

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SPECIALISTS IN INDUSTRIAL WATER TREATMENT FOR OVER 44 YEARS

CUT LEAKAGE 66% OR MORE!

At High Pressures and High and Low Temperatures . . .

Here's a low cost, lightweight valve that cuts leakage to ⅕ or ⅓ of standard leak factors for metal seat valves. Assures reduced leakage at pressures as high as 6 000 psi with drops to 1200 psi, and temperatures from −300°F to +1500°F! Ideal for controlling fluids not compatible with rubber. Available in 4" to 72" sizes with manual or power operator and in any castable alloy.

FISHER-CONTINENTAL

PISTON RING BUTTERFLY VALVE

WRITE TODAY FOR BULLETIN 82

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

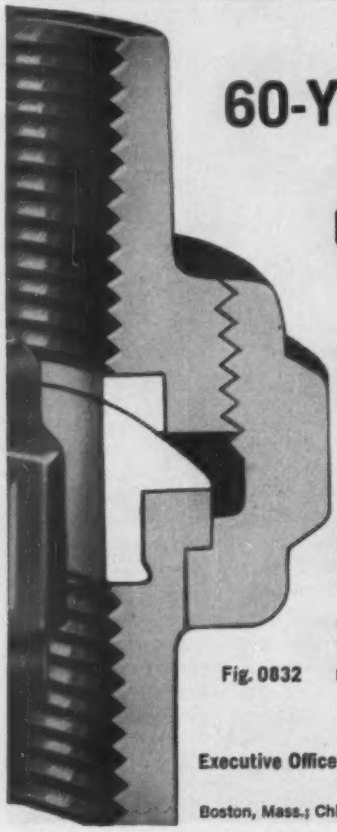
FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario
Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIP. CO., CONCORDIA, PA.

CONTINENTAL FISHER Controls

For more facts circle 925 on Reader Service card, p 207



60-Year Guarantee Backs Dart Unions

For over 60 years every Dart Union has been backed by the firm GUARANTEE that "if one should leak through, we will give you two". Less than 1 in every 100,000 has proven faulty.

The extra wide bronze seats, ground on specially designed machines to a true ball and socket joint, are swaged under heavy pressure into air-refined malleable iron bodies. They come apart readily and remake repeatedly without excessive wrenching — without jamming. They are the reason that Darts may be used over and over again.

Sizes: ⅛" thru 4 inches
Pressure ratings: ⅛"-2"— 300 S.W.P., 600 W.O.G.
2½"-4"— 250 S.W.P., 600 W.O.G.

Fig. 0832 Darts also available in the all-iron construction.

THE **Fairbanks** COMPANY

Executive Office: 393 Lafayette Street, New York 3, New York

Branch Offices:
Boston, Mass.; Chicago, Ill.; New York, N.Y.; Pittsburgh, Pa.; Rome, Ga.

For more facts circle 926 on Reader Service card, p 207

Mechanical transmission

Begins on page 264

102-A. Units are malleable. Browning Manufacturing Company

563 **Electromagnetic clutches** with torque capacities from 1.8 through 13,000 lb-ft are detailed in 20-p booklet R-6304-1B. I-T-E Circuit Breaker Company

564 **Gears** for speed-reduction or speed-increasing service on high-hp transmission applications are described in 8-p bulletin 2401. De Laval Steam Turbine Co

565 **Spherical roller bearings** are detailed in 52-p booklet 2760. Design features, selection data, formulas, diagrams, photos, charts included. Link-Belt Company

566 **Tapered roller-bearing** pillow blocks are featured in bearing-unit bulletin BU-103-A. Browning Manufacturing Company

567 **Sliding journal bearings,** tilting-pad journal bearings and tilting-pad thrust bearings are topics of three new catalogs W-1, W-2 and W-3. Waukesha Bearings Corp

568 **Aluminum** used as bearing material is subject of 12-p brochure. Tabular data, economic advantages are listed. The Bunting Brass and Bronze Company

• Couplings

569 **Coupling with zinc-alloy flanges** and flexible unit are covered in 16-p bulletin 5103—engineering data given. T B Wood's Sons Company

570 **Motor couplings** are described in leaflet 2875A. Couplings have corrosive-duty covers of polypropylene. Link-Belt Company

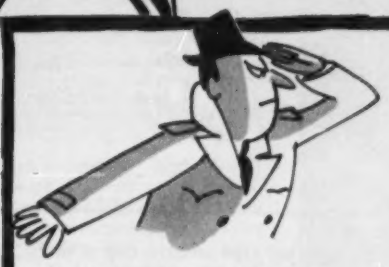
571 **Flexible-coupling catalog 60** supersedes catalogs 51, 51A. Description of misalignment, selection guide are given. Thomas Flexible Coupling Company

572 **Flexible-coupling engineering** catalog 60 has 50 pp, numerous photos, charts and diagrams describing firm's products. Applications of new styles, couplings for special conditions are also shown. Thomas Flexible Coupling Company

573 **Flexible-cushion couplings** ranging from 190 hp per 100 rpm to 2000 hp at 1080 rpm are featured in 12-p bulletin A669C. Dodge Manufacturing Corp

Just circle key numbers on Reader Service card, p 207, to get complete story

HOW TO SLEUTH OUT THE TRUTH ABOUT EXPANSION JOINTS



1 **Case the joint (design, that is)**

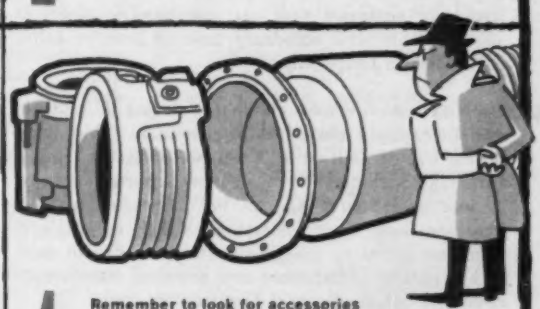
Badger S-R Expansion Joints have: 1. Corrugations which assume "all curve" shape under pressure — low stress, long life. 2. Tubular rings allow flexing over more of corrugation height.

2 **"Weigh" the evidence**

S-R Joints have no bulky castings . . . weigh up to 50% less . . . diameter equivalent to pipe flange. Installation is easier, lighter supports required.

3 **Search for clues in fabrication methods**

Bellows are hydraulically formed to produce uniform corrugations with minimum thinning of material. Quality controlled longitudinal welding, no multiple circumferential welds.



4 **Remember to look for accessories**

Full line of accessories — including covers and liners. Easy to pick proper combination of model, type and accessories for any pressure, temperature, erosive or corrosive condition.

5 **Pull an M.O. on the manufacturer's background**

Badger's 50-year experience includes development of first successful self-equalizing design for higher pressures, temperatures. Badger has had more fabrication and engineering experience in more different applications than any other manufacturer.

6 **Close the case — buzz Badger**

See the Badgerman for expert help on your most exacting pipe expansion problems. He knows his business, your problems. Call or write today.

BADGER *Expansion Joints* **S·R**

BADGER MANUFACTURING COMPANY
230 Bent Street, Cambridge 41, Mass.
Representatives in Principal Cities

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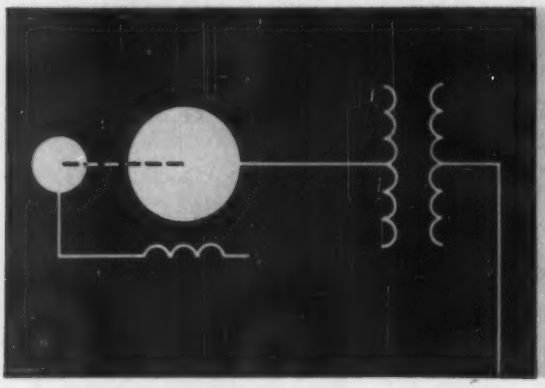
For more facts circle 927 on Reader Service card, p 207



Standby generation is being specified in an increasing number of industrial plants and commercial buildings in line with high cost of outages. Key operations may have their own source as well as one for emergency lighting and communication. Quality of standby power is upgrading as well as quantity. Manufacturers respond with comprehensive lines of engine-driven and battery sets.

Building-block principle for large power transformers will probably see wider adoption.

Norman Peach
Associate Editor

Generation, transformation and conversion

140 **Engine-generator** weighs just 123 lb. The 4-cycle aluminum engine is the heart of a portable, compact power plant rated 2500 w, developing up to 3000-w ac intermittent power. You can get full power at 115 or 230 v from one outlet, manufacturer states. Regularly equipped with carrying handle, model is also available with stationary base or 2-wheel dolly. —Wincharger Corporation

141 **Static-excitation system** eliminates moving dc unit for medium-capacity steam turbine-generators. This 90-kw system will be used on a 25,600-kva generator. Prime advantage is elimination of all moving parts for maintenance ease. Servicing can be undertaken without removing load from generator. Power is obtained from connection to generator terminals. Circuit uses both a current transformer and potential transformer as power source.—General Electric Company

142 **Smaller and lighter transformer** does same job as conventional units but uses cores nested together to reduce magnetic circuit's resistance. U-shaped cores are simple, will fit into already-designed equipment and systems. According to manufacturer, this smaller transformer may permit designing more compact electrical equipment without changing operating characteristics. Core consists of laminated nests of steel strips fabricated from a continuous roll. Each core has two U-shaped nests of strips which fit together by meshing strip tops.—Sylvania Electric Products, Inc

143 **Dry type transformers** for 400-c systems, single and three phase, are rated 500 kva, 600 v and below. They operate for assembly-line test facilities, ground power supplies, portable test equipment and any 400-c distribution system. Construction allows mounting in any position.—Westinghouse Electric Corporation

144 **Bushing type** external-mounted current transformer eliminates untanking and protective housing. It's designed for circuit relaying, indicating or protection. Install on existing units merely by slipping ct down over a power bushing. Use it with any standard ASA bushing, 34.5 kv or below.—Allis-Chalmers Mfg Co

145 **Butyl-molded current transformer** of 600-v line is specifically for indoor application. Comes with high-base or low-base bar type construction with 200, 400, 600 and 800:5-amp ratings. A feature is low price made possible by design simplification and standardization of models.—General Electric Company

146 **Distribution-equipment transformers** come in conventional units with 300- to 2500-kva rating and stacker type units with rating of 112¼ to 225 kva. They handle service as integral distribution center or substation load-center transformers, step down plant distribution voltage to utilization voltages. Units are said to be lighter than previous models, mechanically stronger and rugged. External design features welded flanges to eliminate rust and corrosion-prone openings.—General Electric Company

147 **Brushless alternators** are built to handle 400 c. First unit of brushless line covers 1- to 15-kva range, is equipped with transistorized voltage regulator. Maker claims device provides more power on smaller frame (15 kva on 256 NEMA). Solid-state-exciter voltage regulator uses semiconductors and highly stable voltage reference—a virtually drift-free all-static device. —Leach Corp, Inlet Div

148 **Voltage-regulator-exciter** regulates output voltage of any 60-c generator or exciter requiring full-load dc field supply of 10 to 25 amp at 130 v or less. Generator becomes self-exciting since ac input power of 208 to 240 v, 60 c is obtained either directly from generator or through transformer on generator output. Tubeless magnetic-amplifier unit is shockproof, has no controls in main circuit.—Fidelity Instrument Corp

149 **Feeder-voltage regulators** are for use wherever a 3-phase load is to be regulated. Completely automatic and self-contained units, 60-c 3-phase step type, are rated 500 and 750 kva for 8.66- or 13.2-kv circuits. Features: 16-step voltage regulation over 20% range resulting in fewer operations and extended contact life, voltage-regulating device and time delay which monitors voltage and corrects abrupt change.—Westinghouse Electric Corporation

150 **Static, magnetic voltage regulators** are designed for 3-phase circuits from 50 to 2000 kva. They serve very large machines or entire plant departments. Automati-

STEAM TURBINE-GENERATORS

By N. K. Halsteen, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

In 1901, Brown Boveri built the first steam turbine installed on the European continent. This turbine was also the world's largest. Since then, the company has made many basic contributions to turbine design and has built more than 5300 steam turbines for generating electric power and for driving blowers and compressors.

Brown Boveri steam turbine-generators include these types and sizes:

Condensing units offer highest efficiency, lowest steam consumption. All ASME Preferred Standard sizes. Single-shaft units to 350 mw. Cross-compound units to 500 mw and up.

Back-pressure units are rated at 500 to 30,000 kw and supply exhaust steam at 20 to 350 psia for low-pressure condensing units or for process.

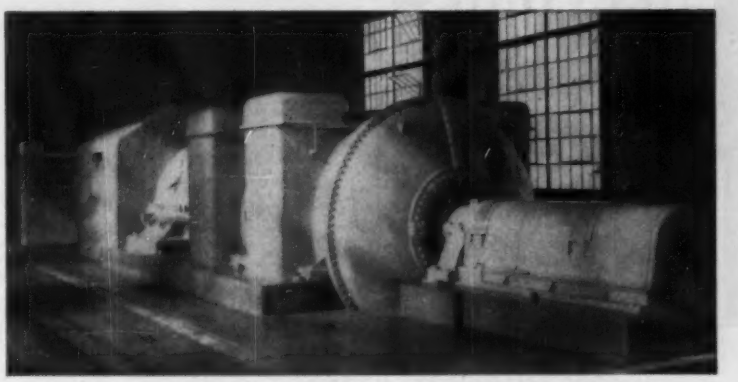
Extraction-condensing units are rated at 1000 to 100,000 kw. Extraction steam at 7 to 15 psia is used for process and for heating water in municipal heating systems.

Sectional rotors

Brown Boveri turbine rotors are made of forged sections welded together at the rims. This construction offers advantages over one-piece rotors: The relatively small size of each section ensures a more uniform forging and allows more thorough inspection. Sections with flaws are rejected and replaced virtually eliminating patching often required to salvage large one-piece forgings.

Asymmetries are cancelled out by the random positioning of adjacent sections. The low weight of a hollow, sectional rotor provides fast warm-up and rapid, uniform heat distribution in service. The sectional design eliminates axial stresses. Completed rotors are given ultrasonic tests and stress-relieving heat treatment. *No explosions or other serious failures have ever been experienced with Brown Boveri sectional rotors.*

Sections of a steam turbine rotor before welding. Welding is done automatically by an inert-gas process.



A Brown Boveri 30/33 mw Preferred Standard unit at Greenwood Mills, S. C.

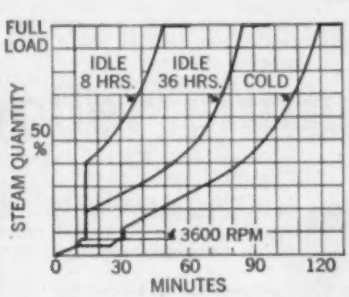
Hydraulic governing system

The Brown Boveri all-hydraulic, governing system uses no mechanical links and thus eliminates joint play or thermal expansion of links which may cause "hunting." Synchronization is quick, simple. On high-temperature reheat units, the governing system is separate from the lubricating oil system and uses a non-combustible fluid.

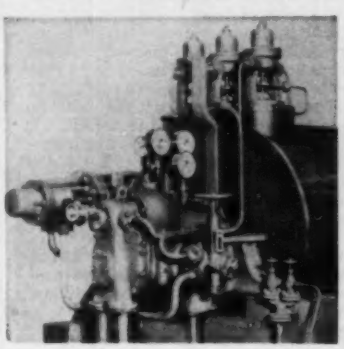
Fast start-up, flexible loading

The low weight of the rotor, lightweight casings and special flange-heating systems reduce temperature differences in the machine to a minimum . . . allowing fast and cold starts, fast changes in load and fast shut-downs without dangerous expansion differentials. Close radial tolerances can be maintained.

These advantages, together with simple synchronizing, are particularly useful where frequent start-ups are required . . . as for peaking.



Starting schedules for a large multi-cylinder reheat turbine . . . illustrating how quickly temperatures in the machine are equalized.



Brown Boveri linkage-free pressure oil governing system. Turbine may also be started and shut down with a single handwheel.

Service

Brown Boveri maintains installation crews and service shops in the U. S. and Canada . . . also working agreements with Todd Shipyard Corp. and National Electric Coil Co. whose shops can rebuild or repair the largest turbines and generators now in use and who have an outstanding record for fast, efficient service.

BROWN BOVERI Brown Boveri Corp., Dept. P-10, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities.

For more facts circle 928 on Reader Service card, p 207

NEW DE-LINE annunciator has

70% MORE ENGRAVING AREA for more precise trouble legends

PA-102 LOW PRESSURE MILL ROLL LUBRICATING OIL

Scam De-Line annunciators, your systems' sentry, now offers the new MAGNA-PLAC nameplate which provides 70% more engraving area.

The MAGNA-PLAC nameplate gives the engineer increased space to more accurately describe condition variations or to employ larger characters for greater visibility. It is interchangeable with standard Scam nameplates and optionally available *without extra charge.*

Other De-Line features include side or stack mounting for practical, *economical* system expansion; a single plug-in relay for both normally open *or* normally closed contacts; and sequence options *after* installation.

Yes, continuous product improvements such as MAGNA-PLAC, flexible application, ruggedness and reliability are what make De-Line the engineer's annunciator.

Complete Monitoring Systems for Industry

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Representatives in Principal Cities

WRITE FOR MORE INFORMATION on De-Line MAGNA-PLAC. Just sign and attach coupon to company letterhead.

NAME _____

Electrical generation

Begins on page 272

cally and continuously, regulators deliver output voltage controlled within ±1% under line-voltage variations as great as ±10%. Response time is 1.5 c or less.—Sola Electric Company

151 **High-speed generator relay** protects from 3-phase, phase-to-phase, 2-phase-to-ground and phase-to-ground faults. All-static unit needs no auxiliary transformers or other external components. When connected, burden of 0.25 va results on ct operating at five amp, 60 cycles. Minimum operating current of relay is 0.14 amp. —Westinghouse Electric Corporation

152 **Solar cells** with 10% minimum conversion efficiency are now available. High-efficiency cells measure 0.4x 0.8 in. They range from 4000 to 11,500 angstroms; operating temperature range is -65 to 175 C.—Hoffman Electronics Corporation

• Generation, transformation and conversion design aids:

For details circle key numbers, on Reader Service card, p 207

574 **Diesel-electric power houses** recently erected by West German firm are described in four languages in new pamphlet. Diesel Energy Corporation

575 **Diesel-engine-powered** electric plants are detailed in 8-p booklet. Kohler Company

576 **Ac generators,** 2-bearing high-voltage type, are featured in spec sheets—18 models illustrated and detailed. Kato Engineering Company

577 **Generators** and motors are discussed in 6-p bulletin covering motors from 1 to 200 hp, m-g sets from ½ to 150 kw. Imperial Electric Company

578 **Electric plants** in sizes from ½ to 100 kw are subject of 12-p folder. Kohler Company

579 **Gasoline-engine-driven** electric-generating plants are topic of 4-p folder. Specs for both air-cooled and water-cooled units are given. D W Onan & Sons, Inc

580 **Fuel cells,** how they work, problem areas, special features of ion-membrane cell are covered in 12-p booklet available from the General Electric Company

continued

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"How to Cut Your Reading Time" also teaches good reading habits by training the reader to cast his eye down an imaginary column in the center of each paragraph. This practice (columnar reading) allows the eyes to take in more at a glance and increases reading speed remarkably.

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Quick reading goes hand in hand with high comprehension and high business efficiency. "How to Cut Your Reading Time" is published by McGraw-Hill as a service to help busy executives in business and industry. Send today for your free copy to:

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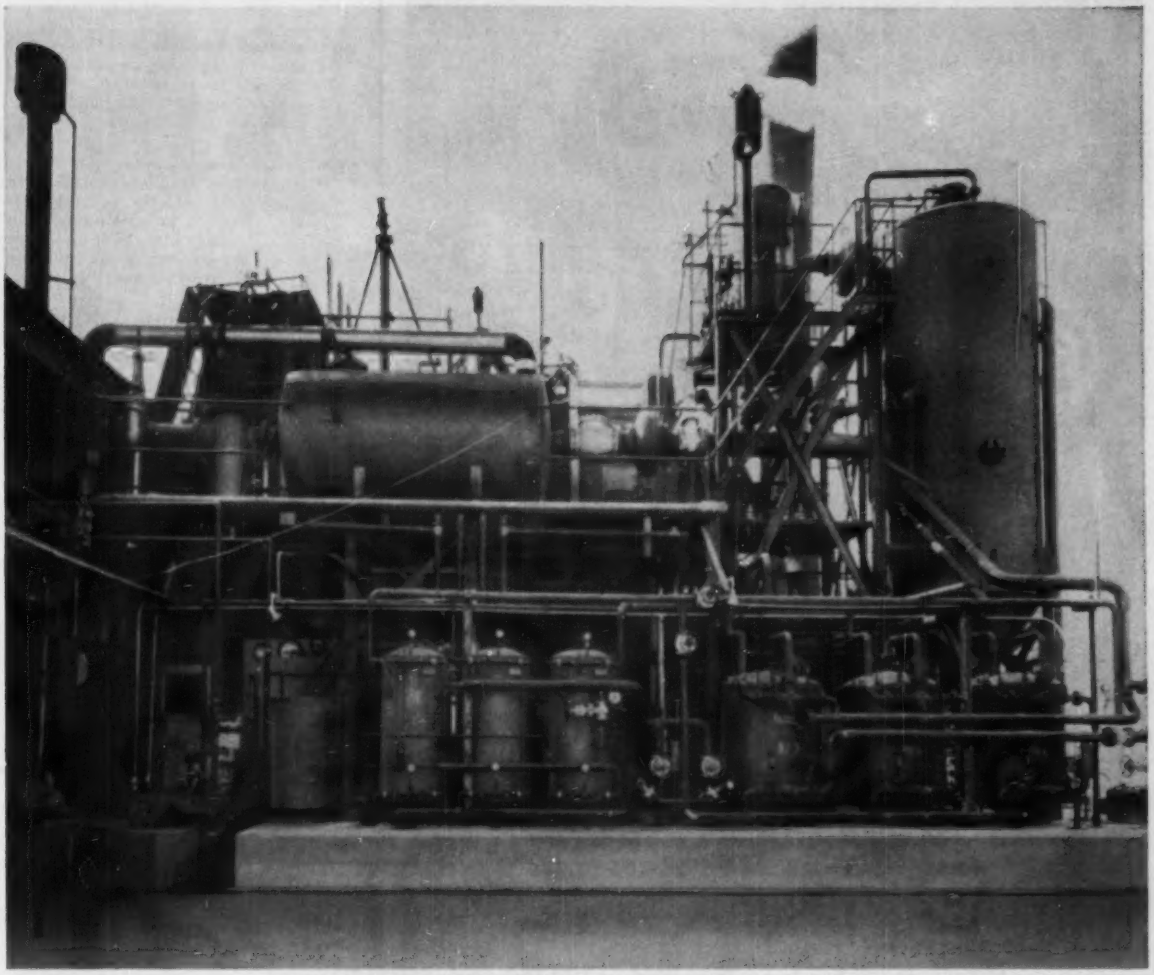
ALLIS-CHALMERS



6000-gph hot lime–hot zeolite water-treating system and deaerator installed at a large West Coast industrial plant.

Hot process - hot zeolite system

eliminates boiler sludge and scale

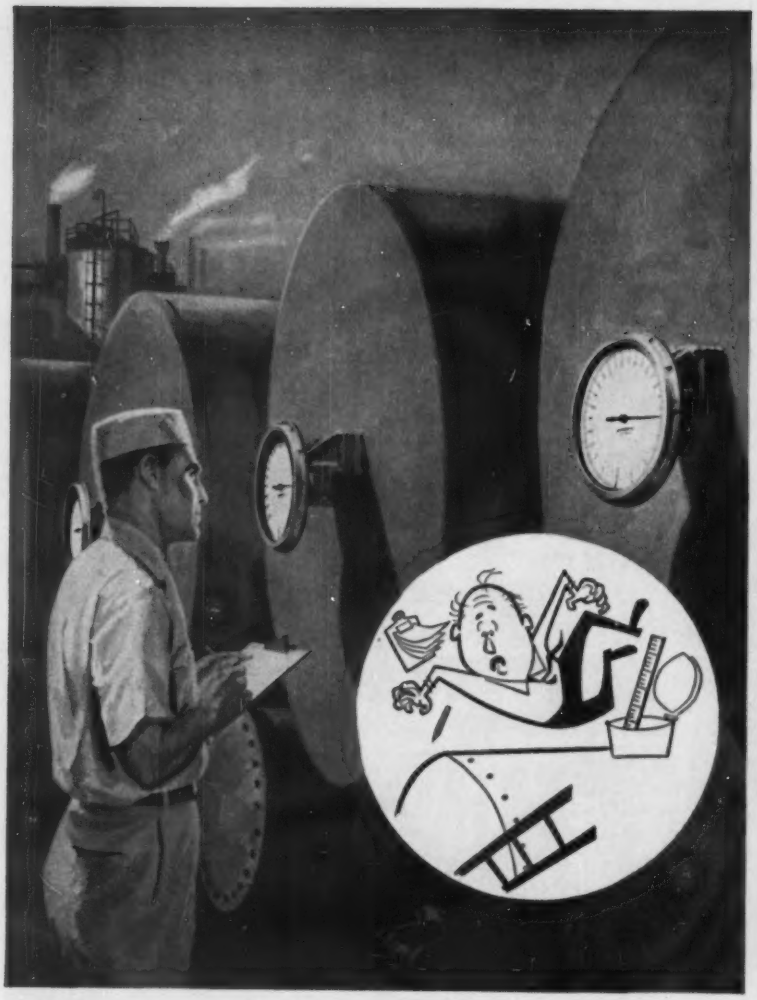
Zero hardness in the effluent — result of Allis-Chalmers highly effective hot process-hot zeolite system — means scale and sludge-free operation of your boilers, economizers, feedlines, feed pumps and feedwater heaters.

In addition to zero hardness, the low alkalinity, silica and solids, and high pH of the effluent make the combined hot process and zeolite systems suitable for makeup to boiler cycles operating at pressures as high as 900 psig.

Your nearby A-C water conditioning engineer can give you further system details or arrange for a proposal or water analysis. ***Allis-Chalmers,*** *Water Conditioning Department, Milwaukee 1, Wisconsin.*

A-1245

One source for all water conditioning facts, chemicals, equipment, service! Write for free hot process-hot zeolite bulletin 28X7559 . . . zeolite water softener bulletin 28B7107A . . . and deaerator bulletin 28B8853.



Reading liquid levels got you out on a limb?

Not if an easy-to-read Liquidometer Gauge is used to indicate exact levels at a glance. It's as simple as telling time... ends potentially dangerous dip-sticking.

Liquidometer Gauges enable one man to read liquid levels safely and precisely—keeping a continuous, right-at-hand inventory – without risking life and limb.

Take the hazards out of liquid measurement—save time, too—by installing reliable Liquidometer Gauges. There is a type available for practically every liquid measuring application.

For complete details, write

LIQUIDOMETER INSTRUMENTS

THE LIQUIDOMETER CORP.

Dept. R, LONG ISLAND CITY 1, NEW YORK

Electrical generation

Begins on page 272

581 **Medium transformers,** open and sealed dry type, distribution equipment, integral distribution centers are described in 12-p bulletin. General Electric Company

582 **Power transformers** for large-substation, transmission-tie and generator step-up applications are described in 44-p publication GEA-6604A. Ratings: from 12,000 to 250,000 kva, up to 230 kv. General Electric Company

583 **Transformer rated to 15 kva,** 600 v is introduced in descriptive bulletin S-202-C. Standard Transformer Company

584 **Service through 10,000 kva,** 69,000 v is handled by these transformers—details in 4-p well-illustrated bulletin 139. Niagara Transformer Corp

585 **Current, potential** and metering transformers are described in catalog S-503. Standard Transformer Company

586 **Transformer hookups** are featured in new catalog. Includes graphs for calculating correction of voltages to 115-120 and 230-240 as a quick method of determining percent required. Acme Electric Corporation

587 **Control-transformer** bulletin 14-B101 has 4 pp, features quick-reference chart for load determination. Acme Electric Corp

588 **Recorder** designed especially for differential transformers is announced in data sheet 794-1. Houston Instrument Corporation

589 **Silicon rectifier-conversion** unit is announced in 4-p bulletin GEA-7060. General Electric Company

590 **Tube-replacement rectifiers,** h-v silicon type, are topic of spec sheet SR-209. International Rectifier Corporation

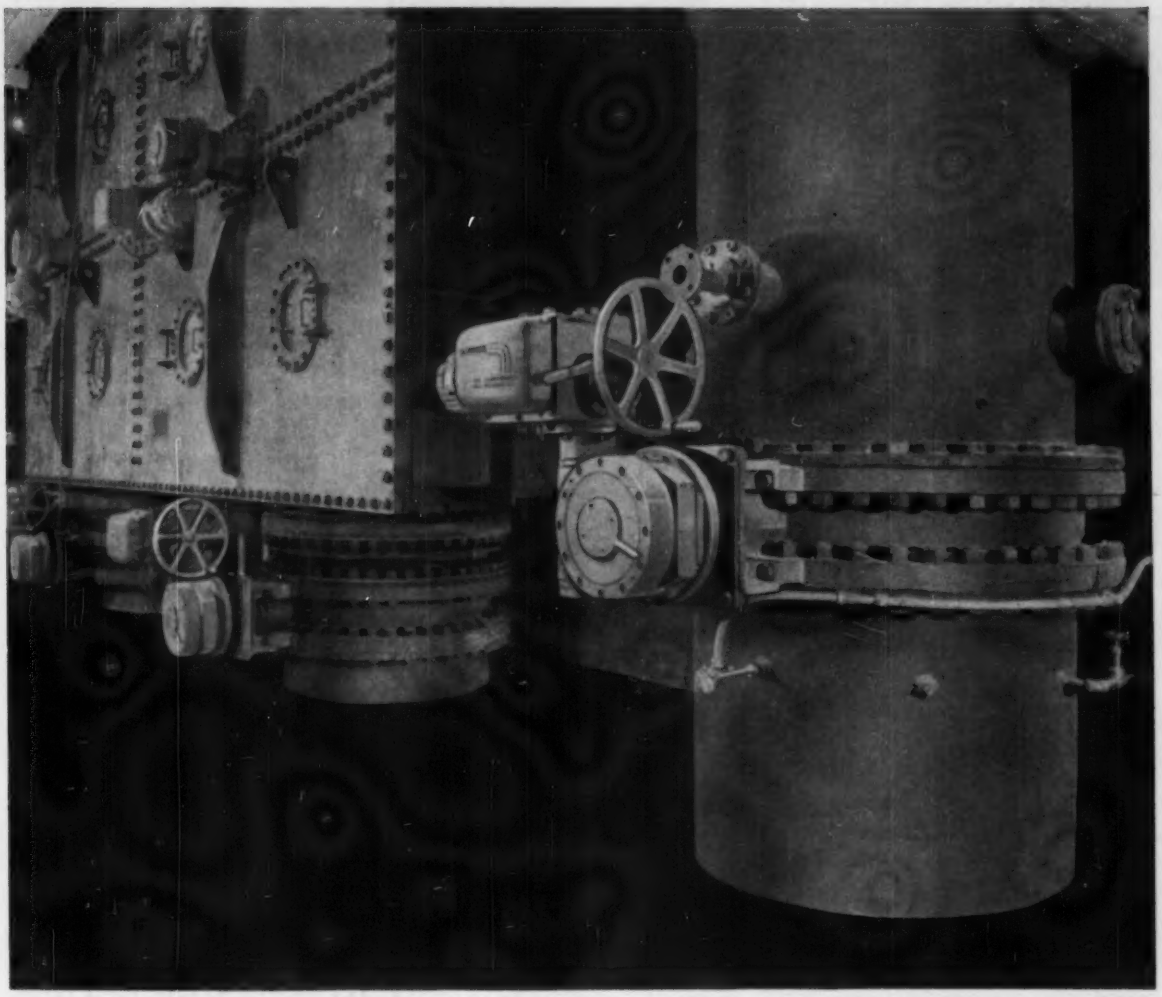
591 **Heavy-duty silicon** rectifier with a rating of 250 v dc, 400 to 2000 kw is described and illustrated in 8-p bulletin. Allis - Chalmers Manufacturing Co

592 **Silicon power rectifiers** for operation at current levels from 1 to 15 amp are announced in spec sheet 71059. Syntron Company

593 **Rectifiers** for load currents up to ten amp, 25- to 35-amp silicon-controlled, are topics of data sheets XSR-310 and XSR-350. International Rectifier Corporation

continued

ALLIS-CHALMERS



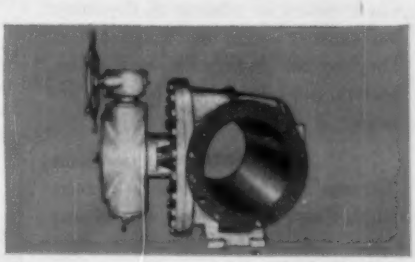
A-C rubber-seated butterfly valves now in service at Potomac Electric Power Company, Dickerson, Md.

65 A-C rubber-seated butterfly valves

selected by Pepco for Dickerson Station

Full body protection is a guaranteed advantage with Allis-Chalmers rubber-seated butterfly valves. Potomac Electric Power Company depends on them, utilizing sizes from 6 to 72 inches in its new generating station at Dickerson. Forty-one butterfly valves are wafer type currently finding application where nonrotary valves once were the *rule*.

Allis-Chalmers rubber-seated butterfly valves are designed to reduce maintenance, eliminate tuberculation and oxidation . . . provide 100% effective shutoff. Operation is always *extra-smooth and easy. For details on our range of butterfly, ball and cone valves for power-plant applications, contact your A-C representative or write* **Allis-Chalmers,** *Hydraulic Division, York, Pa.*

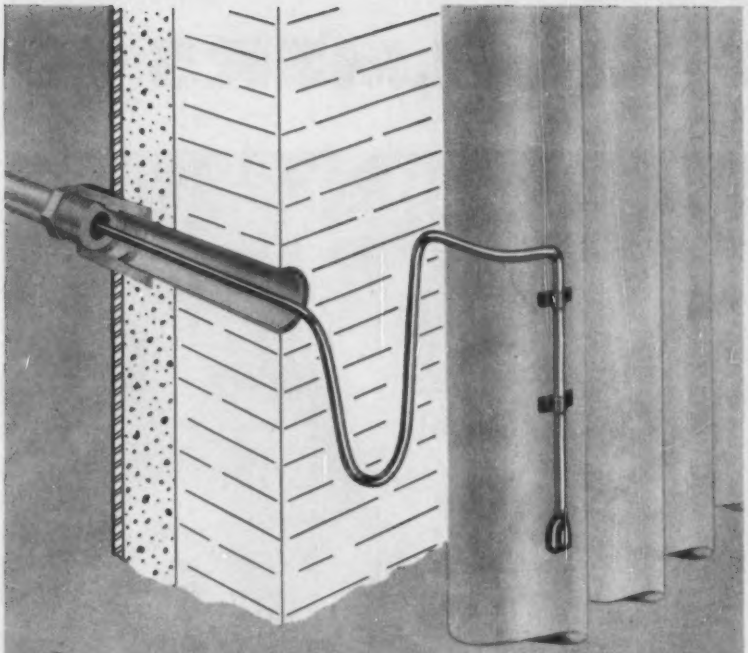


ROTOVALVE units assure the most positive closing offered by any valve. Yet there's no more resistance to flow when full open than with a straight pipe of equal inside diameter. Closing time precisely controllable.

A-1330

Rotovalve is an Allis-Chalmers trademark.

For more facts circle 933 on Reader Service card, p 207



Ceramo® Thermocouples
For Furnace Tube Walls

Cut Installation Time 75%

Installation time, always a high-cost factor with furnace tube wall thermocouples, has now been reduced up to 75% by Thermo Electric. Responsible for this reduction is T-E's "Ceramo" construction—ceramic-insulated conductors with overall metal sheathing. Conventional, rigid assemblies were both costly and difficult to install. "Ceramo" furnace tube wall thermocouples virtually eliminate these difficulties.

Applications

These thermocouples measure the increase in outer tube wall temperature when coking or scaling of the inner wall causes a loss of heat transmission. They are used on furnace tubes, superheaters, pre-heaters, and for determination of start-up temperatures.

Advantages

"Ceramo" furnace tube wall thermocouples can be bent to almost any shape—greatly simplifying difficult installation around tubes.

Large holes in the furnace wall, previously required to accommodate the motion of old-style, rigid assemblies, are no longer necessary. "Ceramo," though basically rigid, will flex with the differential motion between tubes and furnace wall. "Hot spots," resulting from faulty insulation around large, rigid assemblies, are also eliminated.

Since "Ceramo" measuring junctions are completely enclosed, they need only be tack welded to the tube wall. There's no need to seal-weld the entire outer end of conventional, open-end protection tubes. "Ceramo" is generally used *without* protection tubes.

"Ceramo" construction provides extremely small O.D.'s—ranging from 1/16" to 7/16".

Write For Bulletin EDS-45-42.

Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY

In Canada: THERMO ELECTRIC (Canada) LTD., Brampton, Ont.

Electrical generation

Begins on page 272

594 **Flexible silicon power rectifiers** for any voltage and current are covered in 8-p brochure 6101-1A. Info should aid engineers, consultants and scientists. I-T-E Circuit Breaker Company

595 **Power control units** using magnetic amplifiers driving silicon-controlled rectifiers are described in 8-p brochure S-1075. Magnetic Amplifiers, Inc

596 **501- to 5000-kva single-** and 501- to 10,000-kva 3-phase transformers are detailed in 32-p revised bulletin GEA 6103C. General Electric Company

597 **Dry type transformers,** sound rated, are topic of booklet giving product and manufacturing facts. Sorgel Electric Company

Just circle key numbers on Reader Service card, p 207, to get complete story

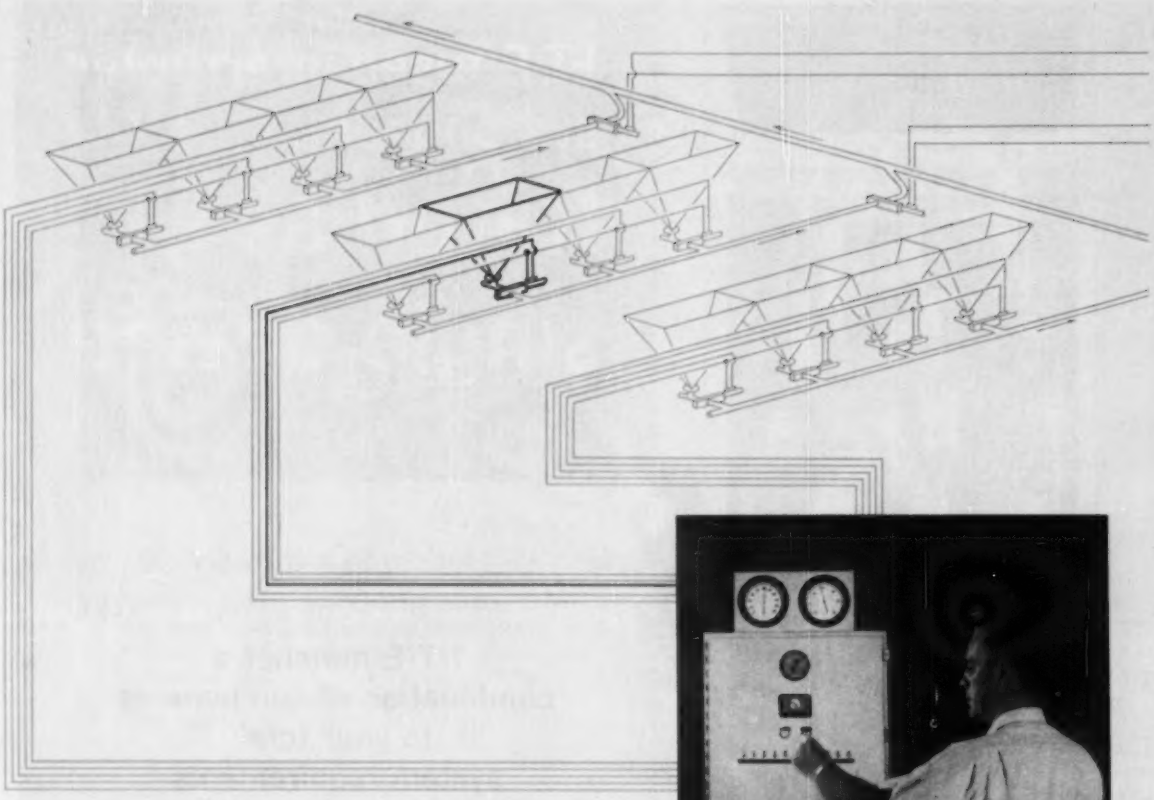
Coming events

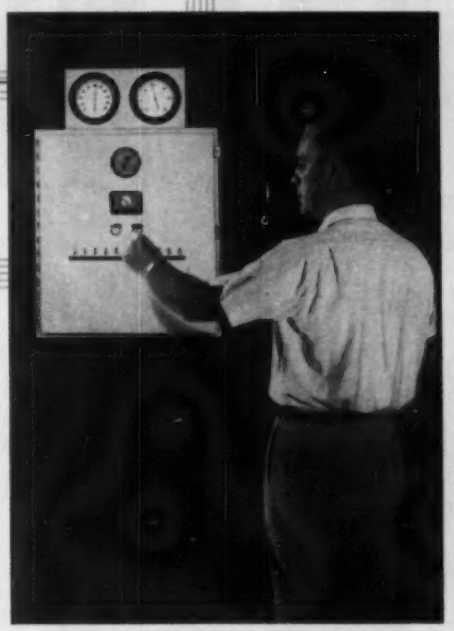
Oct 17-21—American Society for Metals, Metal Shows, Philadelphia Trade and Convention Center. Details: J C Nelson, Metals Park, Novelty, Ohio

Oct 19-21—Society for Experimental Stress Analysis, Annual Meeting, Hotel Claremont, Berkeley, Calif. Details: Prof R F Steidel Jr, SESA, U of California, Berkeley 4, Calif.

Oct 20-21 — American Institute of Mining, Metallurgical and Petroleum Engineers, Los Angeles Basin, Fall Meeting, Huntington Sheraton Hotel, Pasadena, Calif. Details: AIME, 29 W 39th St, New York 18, N. Y.

Oct 23-27 — Technical Association of Pulp and Paper Industry, 15th Engineering Conference, Robert Meyer Hotel, Jacksonville, Florida. Details: E N Wark, TAPPI, 360 Lexington Ave, New York 17, N. Y.





SMALL, FOOLPROOF CONTROL SEQUENCES GIANT FLY ASH SYSTEM

From Allen-Sherman-Hoff comes a new, compact, high-capacity Automatic Sequence Control. Evolved from A-S-H materials handling research-in-depth, the new system introduces several never-before advantages.

It's compact. The unit shown measures about 2 by 2½ by 1 foot overall in standard NEMA 12 cabinet.

Its capacity is practically unlimited. Handles 16 hoppers per cycle and can be made to recycle without limit. Also sequences segregating valves, vacuum producers and related equipment.

It's self-indicating. Has color-coded digital indicator that identifies hopper under control and whether open or closed.

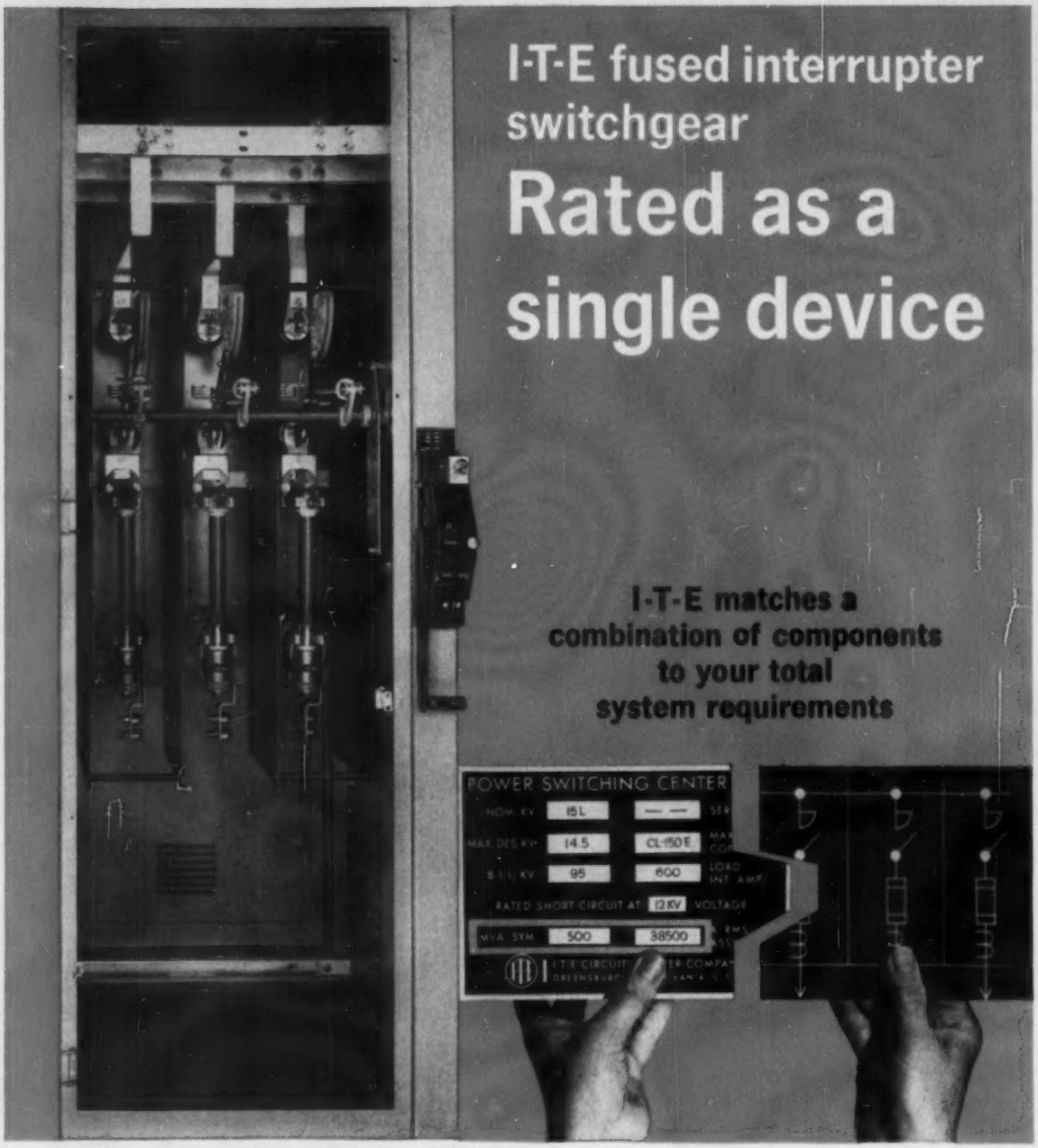
It's foolproof. Is selective for automatic or manual control. Cannot skip a hopper because it performs each operation in two positive steps. However, sequence steps can be bypassed automatically by selection.

The A-S-H Automatic Sequence Control also features simplified circuitry and standard components that require only routine maintenance. It's a new development that's worth knowing about whether you're planning a new ash handling system or modernizing an old one.

Ask for Data Sheet EEb and get full details. THE ALLEN-SHERMAN-HOFF COMPANY, 259 East Lancaster Avenue, Wynnewood, Pa.

ALLEN-SHERMAN-HOFF

MATERIALS HANDLING SYSTEMS

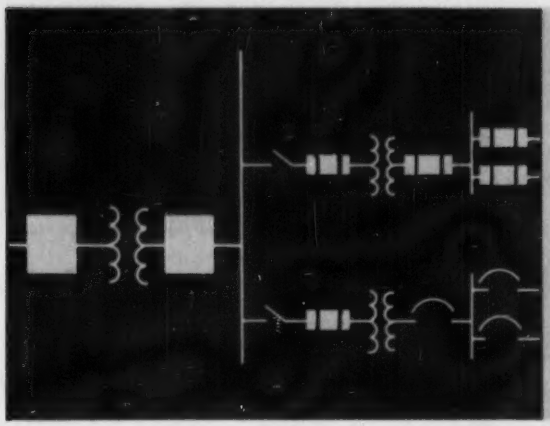


Now you can slash power switching costs and forget a confusing array of ratings. With I-T-E's advanced Power Switching Centers you only concern yourself with specifying your system conditions of operating voltage, available short circuit and load requirements. I-T-E then matches a *single assembly* of switch, operating mechanism, fuse and housing. You are assured of an integrated unit that will safely withstand the effects of *closing*, *carrying* and *interrupting* all values of current up to your system's specific short circuit capability (up to 600 amperes, continuous—500 mva short circuit). Realize maximum economy where *all* the features of circuit breakers are not required. Prevent misapplication of protective equipment with I-T-E's Single Assembly Ratings. Call your nearest I-T-E sales office or write I-T-E at Greensburg, Pennsylvania.

I-T-E CIRCUIT BREAKER COMPANY

For more facts circle 936 on Reader Service card, p 207

For details circle key numbers, page 207



Fused-load-interrupter switches now get a lot of attention as protection for a variety of industrial distribution systems. Manufacturers are bringing out new designs and refining old ones. Controversy on merits of this kind of protection vs circuit-breaker protection can be expected to get hotter before proper domains are established.

New NEMA low-voltage fuse standards are in keeping with design refinements in this area. They spur interest in low-voltage fuse-protected gear.

Versatility of busway systems is on the increase, making them attractive for many jobs.

Norman Peach

Associate Editor

Distribution and protection equipment

153 **Removable switch-and-fuse** element works up to 14,400 v. When switch needs refusing, remove entire element from its cubicle, make replacement without risk of contacting live parts. For system servicing, maintenance man rolls truck-mounted assembly out of cubicle onto floor, works in safety and comfort. Currents up to 10,000 amp won't damage or weld the interrupter. —Continental Electric Equipment Co

154 **Ac indoor switch** interrupts load currents using an auxiliary switchblade. Operating in conjunction with main switchblade, auxiliary breaks an arc drawn between two high-arc-resistant silver-tungsten-alloy contacts in polyester housing plates.—Electrical Engineers Equipment Company

155 **Enclosed precision switch** has adjustable roller arm, die-cast aluminum housing, sealed overtravel plunger and adjustable roller-level actuator. Neoprene-gasketed interchangeable side plates and neoprene boot sealed to the plunger resist moisture, dust and oil. Unit has rating of 20 amp, 125/250/480-v ac.—W L Maxson Corp, Unimax Switch Div

156 **Fused load-interrupter switchgear** closes on 44,500 amp, interrupts 500-mva short circuit at 14.4 kv. Corresponding ratings at 4.16 kv: 60,000-amp fault closing, 250-mva short-circuit interrupting. Load interrupter has integral quick-make quick-break device for high-speed closing—action is sequenced so circuit is made on separate arcing contacts before load-carrying contacts close. Solid-material boric-acid power fuse does the interrupting duty. Multiple-bore construction lets fuse handle low, medium and high faults—expellable boric-acid liner automatically enlarges fuse bore to handle heavy faults. Available in continuous ratings of 200-, 400- and 600-amp fused, up to 1200-amp unfused.—S & C Electric Company

157 **Load-break switch** avoids single-phasing. Current-limiting fuses used in this 15-kv 3-phase outdoor switch are equipped with striker pins. When a fuse in any one phase blows, striker pin trips switch, prevents single-phasing protected equipment. Unit has bil of 150 kv, can be used for operating voltages between 2.4 and 13.8 kv.—Electro Machinery Corp

158 **Lightweight 50-kvar capacitor** weighs approximately 1690 lb and measures 107 in. in length. It includes cast-glass bushings, impregnation with a liquid dielectric, dry-annealed aluminum foil and plated-parallel-groove connectors.—General Electric Company

159 **H-v switch** is especially designed for distributing power from rectifiers to electrodes of electrostatic precipitators. Multideck rotary switch will operate in all types of insulating oils. Housed in its own compartment it occupies one cu yd. Switch is engineered for 100,000 v, one amp, has double-blade action. Structural members are of epoxy resins.—Buell Engineering Co, Inc

160 **Dual-cylinder** double-throw automatic switch-transfer mechanism was designed for power users who would find an extended service interruption disastrous. Activated by loss of preferred-source voltage, unit opens one switch and closes another to instantly transfer to emergency power. Timing device selects from 0- to 30-sec time delay, allowing current breakers to operate properly before triggering cylinder for preferred-source-disconnect switch.—H K Porter Co, Inc

161 **Distribution switchboard** meets operating requirements through 5000 amp—designed for use where service needs range from 600 through 5000 amp, 250 and 600 v. Unit also gives fault protection on short circuits up to 200,000 amp. Modular design lets you add, replace or interchange switches in matter of minutes. Front removal for inspection will not disturb bus or adjacent units.—Federal Pacific Electric Company

162 **Protective work aisle** for 5- and 15-kv metalclad switchgear provides safe conditions for inspection and maintenance in all kinds of weather. Aisle can be mounted directly on piers—no concrete pads needed. Work area is large enough for two breakers to pass in case they have to be interchanged. Constructed of steel with labyrinth seals and neoprene gaskets, unit is said to be sturdy, completely weatherproof.—Federal Pacific Electric Co

163 **Control center** for generating stations provides group control of motors through 200 hp. Centralized in standardized enclosures about 90-in. high, controls are

accessible from front and all wiring is accessible through hinged, full-length rear doors. Steel barriers isolate full-length rear wiring compartment from vertical bus.—Westinghouse Electric Corporation

600-amp contactor for ac electric circuits is designed for continuous duty. Ac coils operate unit at 85 to 110% of rated coil voltage. Insulated for maximum of 600 v, contactor incorporates ac-operating magnet. Available in 2- to 3-pole, front- or rear-connected assemblies with or without arc quenchers.—Westinghouse Electric Corporation

165 **Isolated-phase bus** reduces occurrence of circulating currents. Designed for generator-station service, new duct is arranged so that longitudinal currents circulate in conductor enclosures at all times. This circulation minimizes problems associated with induced currents in structural members parallel to the plane of 3-phase bus duct. Bus features field-welded enclosures reducing voltage buildup between enclosures and ground, can be self-cooled, forced-air cooled or furnished for 105-deg h-t operation.—General Electric Company

166 **Plug-in bus duct** can withstand unusual electrical and mechanical stresses, incorporates lowest possible voltage drop practicable, states maker. XL Bustribution Plug-in Duct comes in amp ratings of 225 through 1000, voltage rating through 600-v ac single-phase, 3-phase and 4-wire, in 10-ft lengths for easy handling and installation. Design makes it almost impossible for an electrician to touch a live bus bar.—I-T-E Circuit Breaker Company

167 **Double-bus design** increasing circuit capacity makes this load center suitable for industrial use. Four rows of breaker plug-in slots permit mounting 100-amp breakers opposite each other; 1-in. increase in panel width doubles capacity for 100-amp circuits. Handles power-panel applications up to 400-amp mains, 240 v and branches of 100 amp.—Federal Pacific Electric Company

168 **Round-edged plastic duct** protects insulation on wires as they are pulled through slots. Edges are especially helpful when wires are installed, also protect insulation from subsequent chafing, cutting and abrasion. Duct is made of nonflammable plastic, includes a snap cover.—Panduit Corp

169 **Bus duct** distributes high-frequency power with minimum voltage drop and little change in phase relationship. Maximum voltage drop at 400 cps: 1.28 v per 100 ft. Duct will operate at frequencies up to 1000 cps.—Westinghouse Electric Corporation

170 **28-kv power cable** has 33/64-in.-thick butyl-rubber insulation. Neoprene outer jacket, 7/64-in. thick, brings ID to 2.3 in. Cable should find use as primary leads for generators, transformers and other distribution equipment in generating stations and distribution subs. It tests at 120-kv ac for five min, 150-kv dc for 15.—H K Porter Co, Inc, National Electric Div

171 **Portable cord reel** provides many outlets from one power source. Model 910, with cord capacity up to 375 ft, has a heavy steel frame, carrying handle and rewind knob.—Daniel Woodhead Company

172 **Gas-driven conduit snake** saves time by eliminating need for snaking wires through ½- and ¾-in. conduit with metal tape. Expansion of a harmless gas propels lightweight line package through conduit. Nylon line is then used to pull polyethylene rope and wire through pipe.—Jet Line Gun Company

173 **Control-station condulets** are designed specifically for hazardous areas indoors and outdoors. Safety seals stand up under driving rain and hose washings, says maker.—Crouse-Hinds Company

174 **4160-v circuit breakers** and switchgear give faster fault interruption and close contacts faster than any comparable equipment in this range, maker claims. Besides compact size, equipment features low weight and low center of gravity. Stored-energy closing is provided by a motor-charged spring-powered mechanism. Since there's no iron in magnetic blowout, arc-chute weight is reduced for easy handling. One safety feature: closed-door drawout lets you go from operating to test and disconnect positions while door remains shut for personnel safety. You can find out breaker's position with compartment doors closed.—I-T-E Circuit Breaker Company

175 **Single-tank oil breaker** incorporates vertical interrupter which permits tank to safely contain all three phases. With subtransmission ratings of 14.4, 23, 34.5 and 46 kv, mva from 500 to 1500, breaker provides 5-c interruption and 20-c reclosing as standard performance. New design offers shorter arcing time, reduced oil contamination and contact erosion. Servicing only one tank, you save 30 to 80 gal of oil.—I-T-E Circuit Breaker Company, Kelman Power Circuit Breaker Div

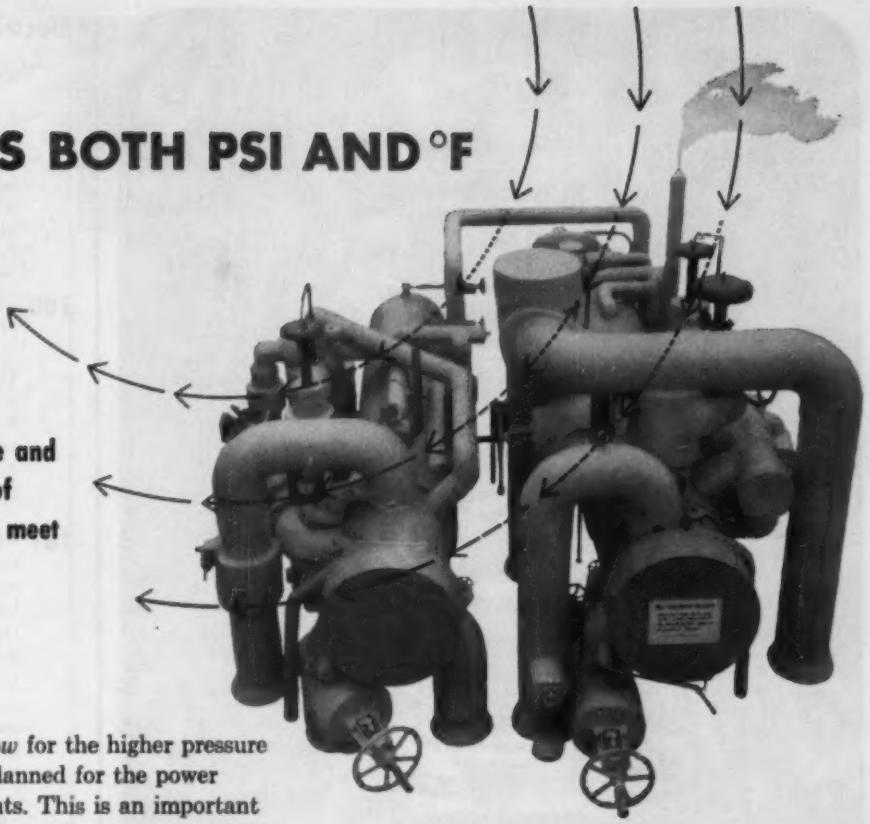
176 **Outdoor switchgear housing** is made of extruded-aluminum panels snapped together to provide a maintenance-free structure. Surfaces require no primers, enamels, sealers or periodic repaintings. Snap-tight interlocking panel edges form permanent leakproof joint. Available in all sizes and voltage classes.—Allis-Chalmers Manufacturing Company

177 **Completely enclosed device** mounts on disconnect switches to interrupt currents of 600 amp, up to 34.5 kv. Test demonstrated that disconnect switch and interrupt device opened and closed successfully with more than ¾-in. coating of ice, maker claims.—H K Porter Co, Delta-Star Electric Div

178 **Circuit breaker** lets you up number of circuits without having to increase size of panel. A regular 8-circuit panel will accommodate eight lighting or general-purpose circuits plus main double-pole breaker and a double-pole range breaker. Unit has two separate protective elements—a coil type solenoid and a thermal bimetal. Bimetal provides built-in time delay, prevents nuisance tripping for nondangerous overloads. High overloads or shorts set up a magnetic field in the solenoid, instantly releasing latch and opening the circuit.—I-T-E Circuit Breaker Company, Bulldog Electric Products Div

179 **Manually operated** stored-energy mechanisms are available in 1-v power circuit breakers, frame sizes Ak-2-50, 75 and 100, rated 1600, 3000 and 4000 amp, to 600 v. Spring-close mechanisms provide positive,

YUBA LICKS BOTH PSI AND °F



Exclusive Multilok Closure and all-welded construction of Yuba Feedwater Heaters meet requirements of newer generating stations

Yuba has the products *now* for the higher pressure and temperature ranges planned for the power industry's new steam plants. This is an important reason why Yuba Feedwater Heaters are so widely specified throughout the industry today. Operating in the 4,000 PSI, 1,000 °F range now, Yuba Feedwater Heaters, incorporating the exclusive *Multilok Closure*, are suited for all future pressure and temperature developments.

Advanced engineering keeps Yuba ahead . . . the new *all-welded construction*, for example. Shells are welded to channels without flanges, eliminating possible leakage that can occur in other construction at high pressures and temperatures. For low and intermediate pressures, Yuba's bolted design is applicable.

When space is important, Yuba can combine several heaters—effectively designing two or more stages in a single shell. For all your needs, Yuba specialists will discuss with you in detail, the design, construction and advantages of Yuba's *years ahead* Feedwater Heaters.

Other Yuba products for steam power plants include Condensers, Evaporators, Expansion Joints, Heaters, Tanks, Cranes, Structural Steel and scores of other items.

YUBA

specialists in power plant equipment

YUBA HEAT TRANSFER DIVISION

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YUBA CONSOLIDATED INDUSTRIES, INC.

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makes PENNSYLVANIA COMPRESSORS run efficiently...silently...with minimum maintenance.

Stainless steel valve discs lift against a cushion of air in the simple, efficient design of the Air Cushion Valve that makes PENNSYLVANIA Compressors run so silently, so dependably, and with such low maintenance requirements. Air Cushion Valves have no nuts, bolts, or screws to break or burn fast. You get longer valve life . . . eliminate wear . . . eliminate noise caused by metal striking metal. Flat valve discs have no flexing or bending action to weaken or distort them. And the valve springs are highest grade stainless steel, rolled on edge, insuring maximum strength and durability. There is just one spring for each disc, and it bears evenly on the entire surface.

But this is only part of the PENNSYLVANIA story. Learn all the facts in "Compressors for Industry". It describes PENNSYLVANIA Compressors from 10 to 350 hp, horizontal, angle, and OILFRE models. Write to Dept. D-10 for your copy today.

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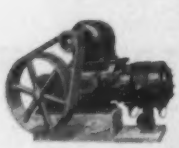
PUMP AND COMPRESSOR COMPANY
Easton, Pa. • Earning Customer Confidence Since 1920



Electrical distribution

constant, high-speed contact closing for greater safety and longer life. Self-aligning mechanism reduces wear.— General Electric Company

180 **Low-impedance** high-shock breaker with 5- to 75-amp rating features inverse time-delay action. For use in electronic applications, unit has thermal bimetal and independent magnetic trip element and is available with or without auxiliary switch.—General Electric Company

181 **Breaker-interrupter hybrid** is rated 34.5 through 138 kv—resembles load-interruptor switch but works like circuit breaker. Designed for h-v switching, unit mounts, opens and closes like a load interrupter, but carries current continuously through its interrupting element like a circuit breaker. Suggested applications include transformer switching, load dropping and switching.—S&C Electric Company

182 **Fuse-breaker**—600-v coordinated unit—includes 1-v power circuit breaker and c-l fuses. Primary application: service-entrance and feeder protection where high fault current exists. Rating is up to 1600-amp continuous and 200,000-amp interrupting capacity.—Federal Pacific Electric Company

183 **High-capacity fuse** offers full overload protection, safely interrupts fault current high as 200,000 amp, limits let-through current to low values. Fuses will hold a 500% load for 10-sec minimum. Overload feature prevents blowing on motor-starting currents or other harmless overloads. Circuit can be fused close to full-load current without fear of needless blowing. Manufacturer's tests show fast opening of fuse on a heavy fault prevents building up a damaging peak value of current. In protecting circuit components against thermal and mechanical stresses, let-through current is restricted to safe values. Available in a full range from 15 to 600 amp at both 250- and 600 v for installation in standard fuseholders.—McGraw-Edison Company, Bussman Manufacturing Div

For more facts circle 938 on Reader Service card, p 207

Begins on page 282

184 **Compact circuit breaker** rated 200 amp features companion strip for effective dielectric separation of breaker contacts. Two poles are located in separate compartments within case, linked externally by a single handle. Hydraulic timing element creates a controlled inverse time delay. Kick-spring provides tripping action when overload occurs on either pole.—Heinemann Electric Co

• Distribution and protection design aids:

Just circle key numbers on the Reader Service card, page 287, to get complete product story

598 **Load-center** unit substations providing continuous power for ac-distribution systems—300 to 2000 kva, 600 v and below—are introduced in 32-p bulletin GEA-3592L. General Electric Company

599 **Primary unit substations** with incoming ratings of 6900 through 69,000 v and outgoing ratings of 2400 through 13,800 are featured in 4-p bulletin S-2701-1A. I-T-E Circuit Breaker Company

600 **Secondary unit substations** are detailed in 44-p booklet PSG 559. Includes definitions, application data. McGraw-Edison Company, Pennsylvania Transformer Div

601 **Distribution equipment,** low-voltage type, is covered in firm's 84-p "Buy log" GEC-1100B. Covers switches, wireways, circuit breakers, switchboards, motor-control centers, distribution centers, panelboards and busways. General Electric Company

602 **Shallow-depth switchboards** — covered in 6-p brochure 2015. Federal Pacific Electric Company

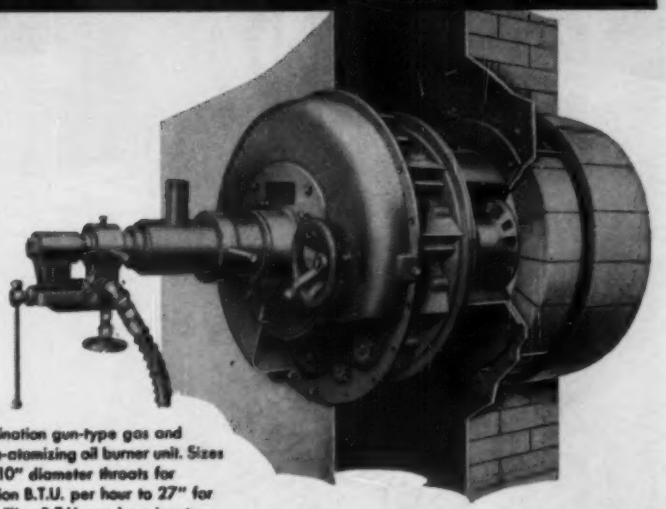
603 **Static controls** for switching and modulating high-amp-ac circuits are featured in 4-p brochure 101. Ovitron Corp

604 **Automatic transfer switches** for service to 600 v, 800 amp, interrupting capacities to 50,000 amp rms are illustrated in 4-p bulletin 07500-G. Lake Shore Electric Company

605 **Rigid-polyvinyl-chloride** electrical conduit is topic of 20-p cata-

ENCO

TYPE E OIL BURNER UNIT



Combination gun-type gas and steam-atomizing oil burner unit. Sizes from 10" diameter throats for 7 million B.T.U. per hour to 27" for 100 million B.T.U. per hour input.

Saves Money and Troubles IN 5 WAYS

1. Vanes can't stick—Easily adjusted

Air register vanes are easily adjusted by a single hand wheel for either clockwise or counter-clockwise air rotation. The action is without stiffness or sticking. Vane shafts are stainless steel — heat-resistant, corrosion-proof — turn smoothly in carbon graphite bearings at all operating temperatures.

2. Positive Vane Control —no lost motion

Chain-and-sprocket air-vane control, with take-up adjustments, assures easy and precise setting at all times. There are no links to wear and wobble with a flopping action of the vanes when they pass dead center.

3. Adaptable to oil or gas —or both

Changeover from oil to gas or a combination of both can be done easily — with comparatively low cost standardized parts—to get the full advantage of variations in fuel prices.

4. For wide range or standard range burners

Registers accommodate standard range or wide range oil burners — mechanical or steam atomizing — and gun type or ring type gas burners—the one best type or combination for your individual needs.

5. Adaptable to all housing designs

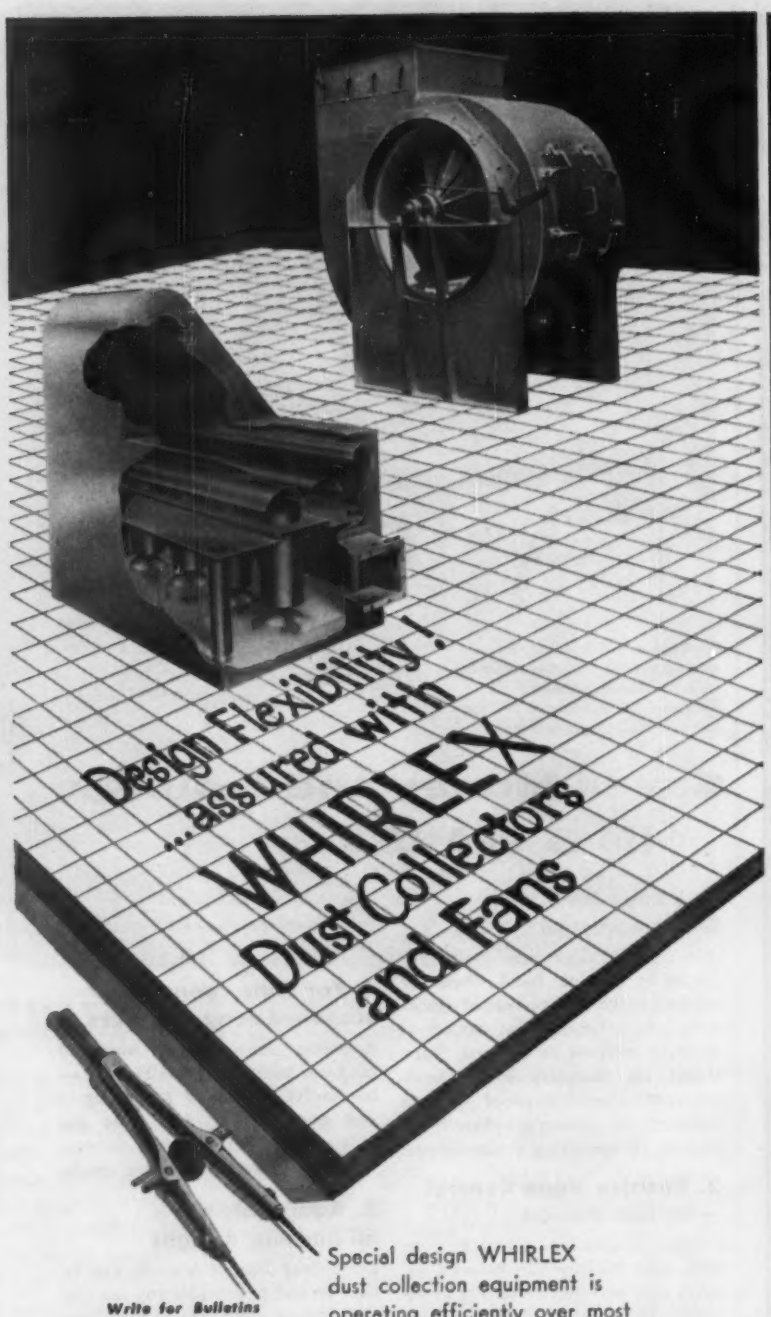
Extra deep burner housing can be used to suit practically any fan and any duct arrangement — with lowest installation cost — and provide proper air distribution for efficient combustion.

Bulletin G59 gladly sent on request

EC513

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.



Write for Bulletins FD-11 & WC-100

Special design WHIRLEX dust collection equipment is operating efficiently over most of the world. Special designs for special applications are a specialty with WHIRLEX!

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420 Lexington Avenue, New York 17, N.Y.

Bag Collectors — Mechanical Collectors — Wet Collectors
Induced Draft Fans — Forced Draft Fans — Exhaust Fans
Self Supporting Stacks — Duct Work

Electrical distribution

log. Test results, specs, installation instructions are given. Kraloy Plastic Pipe Company, Inc

606 **Rigid steel conduit** with organic protective coating over a sherardized zinc surface, epoxy-resin base, is introduced in bulletin 360-C. Walker Brothers

607 **Polyvinyl-chloride compound** and its application in wiring are discussed at length in 4-p bulletin. Alcoa, Rome Cable Div

608 **Glass-tape insulation** for wire and cable is announced in 12-p bulletin WC-8319. Technical data and specs on insulation and new cable construction are included. General Electric Company

609 **Conductors** and electrical joint compound for aluminum-bus conductors are treated in 100-p revision and performance report. Revision lists 10,000 available charts on sag and tension for covered, bare and steel-reinforced aluminum conductors. Alcoa

610 **Silicone rubber** used as cable insulation is topic of CDS-208. General Electric Company

611 **High-frequency bus duct** is topic of 12-p booklet B-7326-380. Westinghouse Electric Corporation

612 **Bus-duct application** data for plug-in high-frequency and electric-utility bus ducts is contained in 12-p booklet 30-660. Westinghouse Electric Corporation

613 **Workbook** to aid in planning unit subs for secondary distribution includes ratings, weights and dimensions. Types of load centers and substations for indoors and outdoors are described. McGraw-Edison Company, Pennsylvania Transformer Div

614 **Power-center planning guide** includes drawings, dimensions, weights, performances of basic units of load-center transformers. Discusses standard arrangements for use with switchgear and other equipment. R E Uptegraff Manufacturing Company

615 **Fundamentals of splicing** and terminating rubber - neoprene cables are given in bulletin 1134. The Okonite Company

616 **Connectors** for solderless wire-splicing and terminating applications are covered in 36-p vest-pocket-sized booklet. Buchanan Electrical Products Corp

617 **Procedures** for making permanent electrical connections to any copper conductor or steel structure are described on wall chart. Burndy Corporation

For more facts circle 940 on Reader Service card, p 207

Begins on page 282

618 **Circuit-breaker** load centers, 150 and 200 amp, are described in 16-p bulletin. General Electric Company

619 **Circuit breakers, low voltage** and molded-case types, are presented with features and advantages in 16-p bulletin SB-CB-1. Multi-Amp Electronic Corp, Multi-Amp Div

620 **Molded-case circuit breakers,** individually enclosed low-power breakers are listed, described with specs in 60-p illustrated catalog of firm's line, designed for quick reference. I-T-E Circuit Breaker Company

621 **Air circuit breakers** for metal-clad switchgear are described in 8-p brochure 3-450. Details on two new types rated 5 kv, 350 mva and 15 kv, 1000 mva are given. Federal Pacific Electric Company

622 **High-speed circuit breakers,** c-l dc type, are described in 4-p bulletin S-4601-1A. I-T-E Circuit Breaker Company

623 **Fuse ratings** for distribution duty based on AIEE specs are listed in bulletin 205. S&C Electric Company

624 **Dual-element cartridge fuses** are topic of 12-p bulletin 1330. Design, construction and operation info is given. Federal Pacific Electric Company

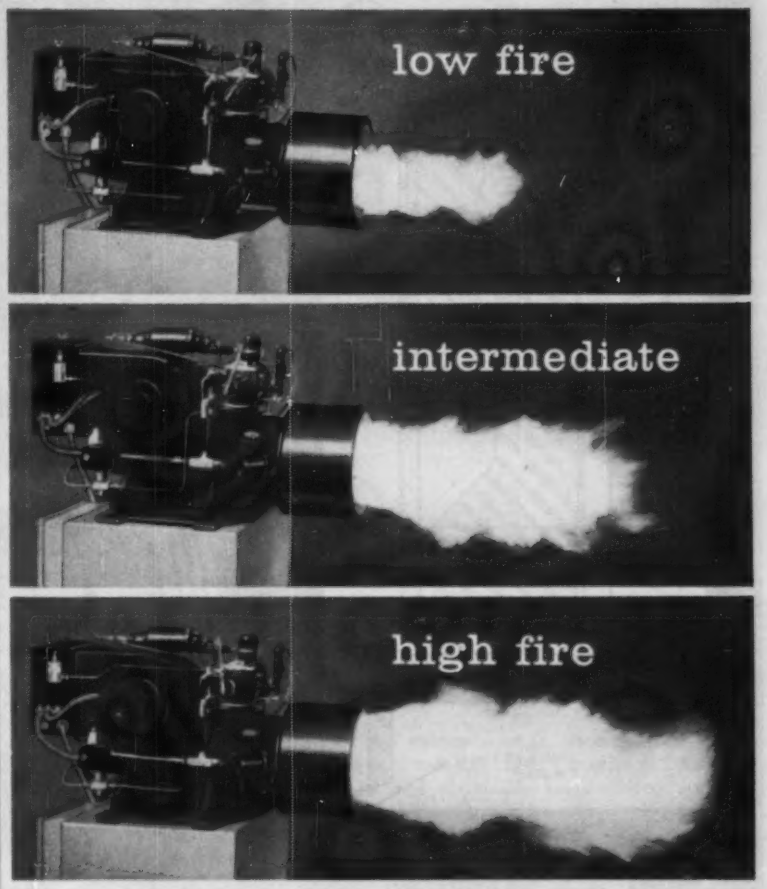
625 **Overcurrent relays** are detailed with application and construction features in 16-p catalog 5-050. Federal Pacific Electric Company

626 **Power - factor capacitors,** low- and high-voltage units to correct plant deficiencies, are described in bulletins 8146 and 8147. Federal Pacific Electric Company

627 **Rotary-handle circuit breakers,** used in switchboards, control centers, panelboards, are topic of 8-p brochure 1425. Rating: from 15 to 800 amp. Federal Pacific Electric Company

Just circle key numbers on Reader Service card, p 207, to get complete story

Burner does a slow burn



for smooth, economical operation

HEV-E-OIL BURNERS start with a low fire, a small flame which gradually builds up to the required size for safe, smooth operation. Low fire and high fire are controlled exactly to assure top efficiency over the entire firing range. Moreover, Hev-E-Oil burners furnish all the primary and secondary air needed for efficient combustion.

Available from 5 to 150 gph. Also combination gas/oil burners from 720,000 to 21,000,000 Btu.

HEV-E-DUTY POWER GAS BURNERS also utilize slow fire build-up for top performance. Air is metered in correct proportion to the amount of gas being used, resulting in high efficiency regardless of chimney draft caused by outside weather conditions.

Sizes from 720,000 to 21,000,000 Btu. For more information on Hev-E-Duty Power Gas, Hev-E-Oil and combination burners, write Dept. P-100.

INDUSTRIAL COMBUSTION INC.

EXECUTIVE OFFICE: 4507 N. OAKLAND AVENUE
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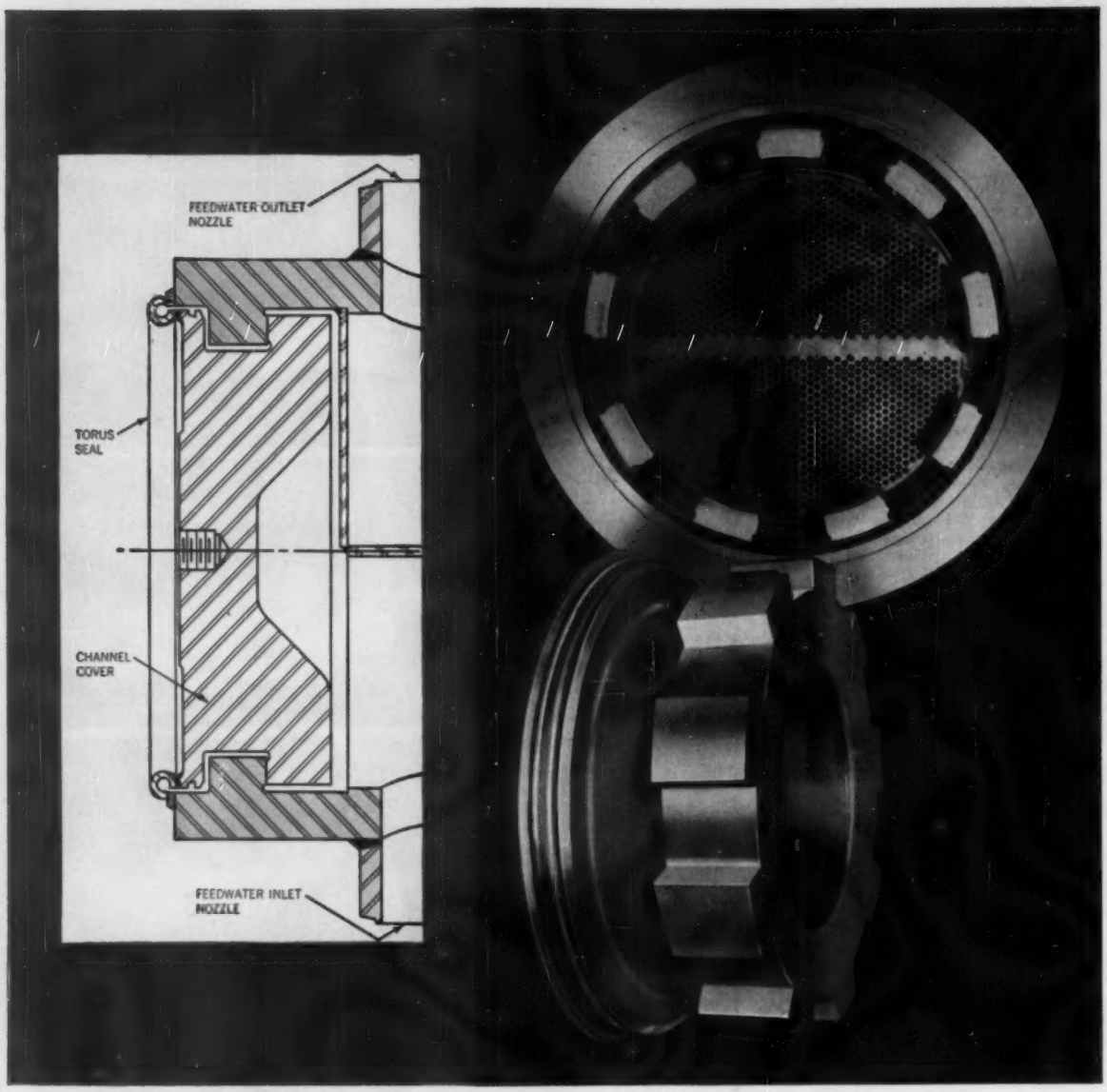


New Breech-Lockhead for Feedwater Heaters

This new closure combines quick-opening convenience with an all-welded seal that is *gasketless*. It is leakproof under the most severe thermal shocks. Yet the pressure cover can be removed quickly with simple tools.

The new Breech-Lockhead closure consists of two parts: (1) a pressure cover that resists the hydrostatic pressure by means of interlocking lugs on the cover and channel, and (2) a torus seal consisting of a partial torus welded to the edges of the channel and cover by a simplified welding procedure.

The torus provides a leakproof seal independent of the hydrostatic pressure on the cover.

Assembly and re-assembly are facilitated by carefully designed tools furnished with the feedwater heaters. The speed, simplicity and ease of the entire operation are worth investigating.

More specific information will be sent on request. Address your inquiries to Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.

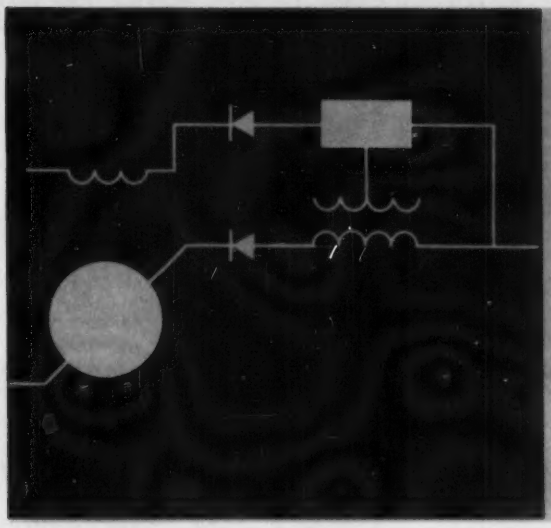
Heat Engineered products, plants and processes . . . for the world's industrial progress.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.

For more facts circle 942 on Reader Service card, p 207

For details circle key numbers, page 207



Adjustable-speed motors are available in such a broad array that there's one to fit almost any drive requirement. Most are based on some ac-dc conversion, with silicon rectifiers and magnetic amplifiers playing an important role.

Overload protection by heat-sensitive semi-conductor devices imbedded in motor windings offers interesting alternative to externally mounted current-responsive thermal devices. Acceptance of these devices, which handle current of starter coils directly, could change control picture.

Encapsulation continues as a trend in motor insulation—silicone rubber in more of the larger designs. Additions to list of insulating materials continue, putting motor makers in better position to match severe operating demands.

Norman Peach
Associate Editor

Application equipment

185 **De-motor speed control** features efficiency over full speed range, high performance reliability. Control presently rated for dc shunt motors up to five hp can be adapted for dc motors of larger sizes. Maker says control assures constant speed regardless of load variation. There are no moving parts—dials permit precise, stepless control. No warmup time is required.—ACF Industries, Inc, ACF Electronics Div

186 **Adjustable-voltage drive** claims quiet operation. Magnetic amplifiers and semiconductors are used for control and rectification of input power. Minimum maintenance is required because components operate well within their ratings, states maker. Static power drives are available as standard packages in sizes ranging from ½- to 200-hp. They feature an 8/1 speed range with 5% regulation.—Square D Company

187 **Ac motor** rated up to 125 hp boasts built-in overload protection. Miniature heat-sensing switches buried in stator windings shut motor off when internal-winding temperature exceeds predetermined amount. System uses only two extra wires.—General Electric Company

188 **Tube-cooled motors** built for trouble areas protect against excessive moisture, oil, vapor, chemicals, coolant and air-borne dust, dirt and metallic particles. Units range to 2000 hp, hazardous or nonhazardous locations. Applications: pumps, compressors, conveyors, fans and blowers.—The Louis Allis Company

189 **Integral-hp ac-dc motors** are suited for mobile-field-equipment applications in remote areas, says maker. Line has ratings through 7½ hp, 1800- and 1200-rpm. Open ventilated motors packaged with four silicon rectifiers in bridge circuit eliminate reconnecting for each type of current.—Robbins & Myers, Inc

190 **Squirrel-cage motors** for outdoor field pumping work over wide voltage range—3- to 75-hp rating. Low magnetizing current gives high power factor even at overvoltage and high starting torque for positive breakaway at low voltage. High-slip high-inertia design cuts current peaks caused by cyclic loading. Both stator and rotor are designed to handle short-time overloads.—Westinghouse Electric Corporation

191 **Drip-proof motors** operate under adverse conditions of excessive moisture, high humidity and temperature, dust, oil and chemically contaminated atmospheres. Silicon sealing compound provides flexible insulation—thin and nonporous yet resilient. Rotor and fan are sprayed with anticorrosion coating. Available in ratings from ½- to 50-hp, any phase, frequency or voltage.—Sterling Electric Motors

192 **Electric-motor-coil insulation** can be applied to random-wound and form-wound 1- to 500-hp motors. For latter type, epoxy resin is applied to core and frame before winding. Then Epa-Seal vacuum-pressure process impregnates entire wound stator. Random-wound motor has entire stator encapsulated by vacuum-pressure system.—Elliott Co, Crocker-Wheeler Div

193 **Connecting stator windings** on large induction motors is made easy with two rings of insulated conductors encapsulated in epoxy resin. Bicycle-wheel-size ring with entrance-cable connections has short leads located at precise points for making series connections among the various coils. Second harness, similarly constructed but slightly smaller, has connections for equalizing phase unbalances and suppressing harmonics.—General Electric Company

194 **Electrical epoxy-resin insulation** can simply be painted or sprayed on electrical equipment subject to h-v discharges. It dries to form a smooth painted surface and at the same time gives standard insulating materials resistance to breakdown by electrical arcing or "tracking."—Westinghouse Electric Company

continued

195 **Motor-alternator** combines 1-piece rotor and cast windings with brushless design for almost maintenance-free operation, states manufacturer. 2-bearing common-shaft 400-c models from 500 w to 10 kva can be furnished.—American Electronics, Inc

196 **Ac motor starter** has unique draw-out contactor and fuse-shelf assembly. Unit is designed to provide short-circuit protection and coordinated control for squirrel-cage, synchronous and wound-rotor motors up to 3000 hp rated from 2300 to 4600 v. Draw-out stab-in contactor and fuse assembly shorten installation time. —General Electric Company

197 **Fluorescent fixtures** have acrylic-base finish to provide maximum reflectivity and light output. Enamel resists stains, prevents excessive discoloration when exposed to ultraviolet light. Fixtures also resist chipping and scratching, says maker.—Edwin F Guth Company

198 **Emergency lighting system** handles four 25-w sealed-beam floodlights. Sensing device turns light on without attention whenever power supply fails. When power returns, unit automatically shuts off, begins recharging. Self-contained unit can be mounted on wall, suspended from ceiling or placed upon floor. —York Lighting, Inc

199 **Quick-disconnect terminal** eases servicing of electric-utility equipment or any motor or generator with hard-to-reach brushes. New quick-disconnect terminal assembly facilitates brush replacement. A stationary clip is bolted to machine, and one or two terminals simply snapped in. All parts are silver-plated beryllium copper for minimum resistance.—National Carbon Company

200 **Automatic emergency-lighting** and power units permit immediate continued operation of critical lighting systems in case of power-line failure. Units provide 115-v ac, feature instant starting, frequency stability and built-in power-factor correction.—American Television & Radio Co

201 **Power load bank** uses thin-plate woven-wire-mesh conductor. Exceptionally lightweight (less than five lb), it is easily carried from station to station. Simulated load bank has low retained-heat capacity and low surface temperatures. Available up to 15 kw, 110 or 28 v.—Electrofilm, Inc

202 **Silicon-regulated** dc power supplies feature low transients, low drift and no spikes. Ratings are from 100 to 1500 amp, 14 to 36 v. According to maker, short circuit across load will not damage rectifiers and transistors. A 400% overload is withstood for one sec without harm to unit.—Sprague Engineering Corp

203 **Explosionproof portable floodlight** for hazardous locations has cast corrosion-resistant aluminum-alloy housing, tempered-glass lens held by a clamping ring. It's suitable for indoor and outdoor applications, permanent installation.—Crouse-Hinds Company

204 **Electrical strip-heater system** preheats low-alloy high-tensile steels to prevent underbead cracking. System should improve weld quality through close, continuous control of heat input to base metal and elimination of cold spots. Reusable interchangeable 1- and 2-ft plug-in units can be added or removed as job requirements change. A system installs in about three hr. —J B Nottingham & Co

205 **Proximity limit switch** is self-contained in 10-cu-in. hermetically sealed brass housing. According to maker, it is impervious to coolants, abrasive dust, dirt and temperatures ranging from –50 to 250 F. Operates without transistors, tubes, coils, relays or amplifier, has only one moving part and requires no power input.—General Equipment and Manufacturing Company

206 **Switch type combination starters** come in NEMA-12 dust-tight enclosures. New feature: a disconnect-switch mechanism with operating handle permanently attached to switch—no danger of false position indication when door is open. Interchangeable fuse clips accommodate 250- or 600-v fuses.—Square D Company

207 **3000-amp dc power supply** for vacuum and pressure-melting furnaces features saturable reactor control of output and silicon rectifiers. This can be used to parallel a power supply of same or dissimilar current ratings. Unit utilizes silicon rectifiers throughout and thus has efficiency of 87%. Air- or water-cooled models are available.—A O Smith Corporation, Welding Products Div

208 **Expanded-scale voltmeters** offer increased readability and precise indication of true rms values. They give readings of alternating voltages even when their frequencies vary or when they are distorted. Voltmeters provide an accuracy of ± 0.5% of center-scale value at 60 c, are temperature compensated from –55 to 70 C. —Daystrom, Inc, Weston Instruments Div

209 **Portable dc unit** tests h-v breakdown. Weighing 20 lb and operating from 110-v ac, unit tests motors, transformers, cables and insulating materials at dc potentials to 5000 v. Operation is automatic; signal lights indicate failures.—Associated Research, Inc

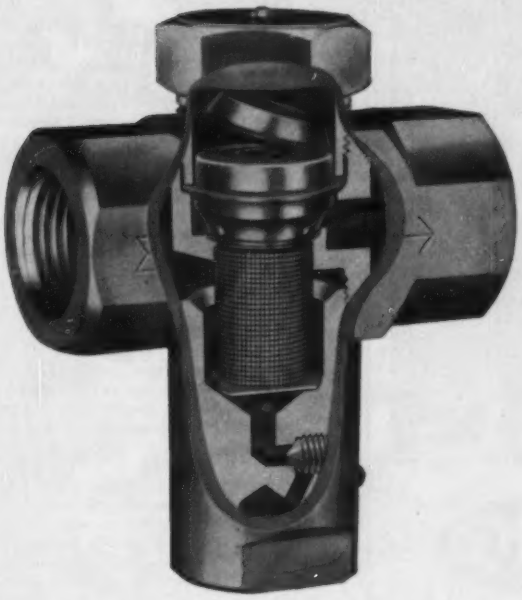
210 **Automatic tester** makes h-v breakdown tests on as many as 50 units at one time and operates for periods up to 12 hr. Insulation-life tester individually and simultaneously checks motors, capacitors, cables. Suggested applications include incoming inspection and maintenance testing.—Associated Research, Inc

211 **Dielectric test set** combines high-potential tester and fault tracer to test cables at voltages to 60,000-v dc and automatically supply tracer current to a faulted cable. The dc tracing-current section provides pulsed power of 16,000-v dc, up to 250 ma at 30,000 v and below.—Sorensen & Company

212 **Relay tester** handles a full range of ac and voltage-activated relays, circuit breakers, current transformers and their insulation resistance. The 2-kva, 240- or 120-v, 60-c single-phase tester has a continuously adjustable transformer for current or voltage load. Dc target and seal-in relays can also be checked.—Multi-Amp Electronic Corp

continued

NEW YARWAY No. 130
IMPULSE STEAM TRAP



YARWAY IMPULSE® STEAM TRAP, STRAINER AND BLOW VALVE... ALL COMBINED IN ONE SIMPLE UNIT

saves money
saves time
saves space
saves work

It's new! It's the ultimate in steam trap *simplicity*, *economy* and *efficiency*. Yarway offers you the new all-in-one No. 130 Impulse Steam Trap—combining steam trap, strainer and blow-down valve in one small body. ***No other steam trap combines such cost-saving, work-saving features.***

This No. 130 Impulse Steam Trap is designed specifically for those thousands of light condensate load applications such as steam main drips, steam tracer lines, meter boxes, and other applications where the Yarway ½" No. 30 trap has proved so successful.

Check these features—replaceable trap valve-seat assembly, all stainless steel construction, woven stainless steel strainer, Allen wrench-operated blow valve, good for all pressures 8 to 600 psi, small size, light weight—***Plus savings up to 30% over ordinary trapping hook-ups.***

Want to try a Yarway No. 130 for 90 days ***Free?*** Just send the coupon today.

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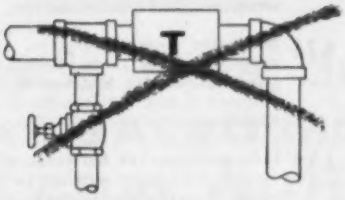

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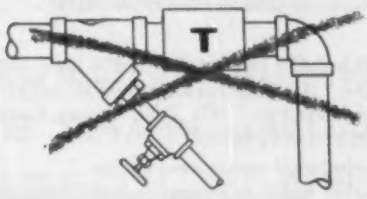
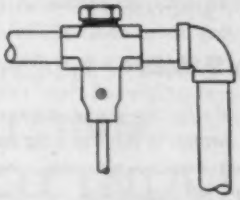


only this



FREE 90-DAY YARWAY NO. 130 TRAP TRIAL — *SEND THIS COUPON* ***TODAY***

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

Yes, we'd like to have a ½" YARWAY No. 130 Trap for 90 days FREE. Please arrange it.

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Company_____
Address_____
City_____ Zone____ State_____

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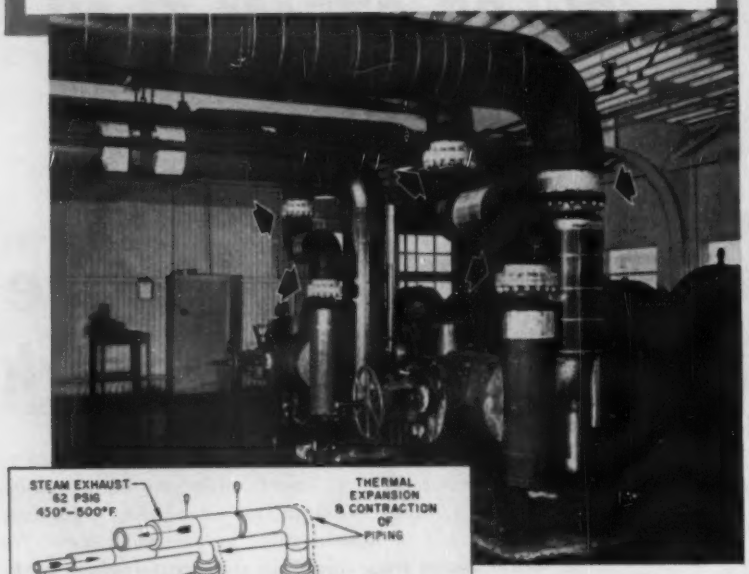
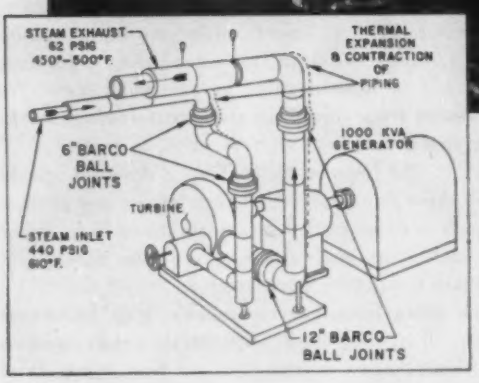
Barco Saves Time, Money on Steam Turbine Piping—





BARCO

BALL JOINTS

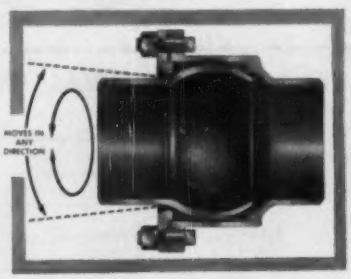
1. Handle Expansion **2. Relieve Torsion** **3. No "End Thrust"**

PROBLEM For the turbine installation shown above, layout of the piping presented involved pipe stress calculations to allow for thermal expansion and to eliminate torsional effects. In addition, a considerable expenditure had to be allocated to cover construction of heavy pipe anchoring and to control expansion "end thrust". *Could engineers find a better way to solve these problems? THEY DID! . . . and they saved about $2,000.00.*

ANSWER Instructions were simple: (A) "Install Barco Ball Joints —two* in each riser near turbine." (B) "Cut loose anchor stops; allow piping to move freely in all directions." (C) "Use spring hanger supports for the long horizontal runs of piping."

*Standard Type N for exhaust; High Temperature Type HT Joints for steam inlet lines.

Barco Ball Joints provide convenient points of flexibility in piping to allow for both expansion and twisting. They develop NO "END THRUST"; expensive anchoring is not required. Easy to engineer. Rugged all-steel construction with no thin wall sections, no critical points of fatigue, no rubber seals. No lubrication required. Sizes and styles to meet your requirements. *Ask for new Bulletin 31B, "Thermal Expansion and Contraction in Piping."*



BARCO MANUFACTURING CO.

5221 Hough Street, Barrington, Illinois

In Canada: The Holden Co., Ltd., Montreal

• Electrical application design aids:

For details circle number on Reader Service card, p 207

628 **Adjustable-speed drives,** all-electric models with low hp of ⅛ through 4, are described and illustrated in 12-p bulletin D-2507. Reliance Electric and Engineering Company

629 **Variable-speed motor drives** are detailed in 88-p catalog. Among data included: speed and hp tables, capacity ratings, dimensions, accessories, modifications and price lists. Included also is a special section on horizontal and vertical models, 25 through 40 hp. Reliance Electric and Engineering Co, Reeves Pulley Co Div

630 **Motor-control catalog** 5900 is 72-p condensed listing of firm's products. Selector charts give hp, motor speed, heater size, heater amp ratings, enclosure choices. Furnas Electric Company

631 **Motor-application guide** 270B for 1/20- to 400-hp motors shows how to match load requirements with motor characteristics — 16 pp. Century Electric Company

632 **Ac-motor catalog** includes pricing and dimensional data for ¼- to 200-hp range, has 56 pp. Special section covers motor selection and application. Sterling Electric Motors

633 **Ac magnetic starters** are topic of 8-p bulletin PL 12-8-160. Enclosures, forms and combinations of all starters are illustrated. Clark Controller Company

634 **Magnetic starters** for 15 hp, 440 to 550 v are introduced in 16-p catalog 14-B1. Describes removable fronts, dual-voltage coils, "trip-free" thermal-overload relays. Furnas Electric Company

635 **Battery chargers** for motors and generators are announced in 8-p bulletin. Covers installation, adjustment and operating methods. The Electric Storage Battery Company, Exide Industrial Div

636 **Re-usable primary battery,** silver-zinc system in full range of sizes from 0.1 to 200 amp-hr, is featured in new bulletin. Yardney Electric Corporation

637 **Industrial storage batteries,** stationary type, are discussed in relation to performance and longer service life in 12-p booklet 4676. Electric Storage Battery Company, Exide Industrial Div

638 **Electrical enclosures** are topic of new bulletin. Wall-mounted floor-stand models are shown. Machinery Electrification, Inc

639 **Modified polyester** insulating varnish for high heat resistance is featured in 6-p form SV-116. Schenectady Varnish Company

continued

SINCE 1956, DUQUESNE LIGHT COMPANY HAS SAVED MORE THAN 15,000 TONS OF COAL WITH AIRFOIL FANS FOR INDUCED DRAFT ON ONE BOILER UNIT ALONE!

How? By using high efficiency airfoil blading to reduce fan motor horsepower. It's possible now with improved pre-cleaning. Duquesne has done it for more than four and a half years on its Phillips No. 4 pulverized coal-fired unit. The generating unit is, in effect, larger by 390 kw on the same initial capital investment – with additional operating savings. The actual figures: $6,000 per year saved in reduced power consumption; $39,000 saved in initial plant investment. ■ Get the facts-and-figures brochure from your Sturtevant engineer, or write Dept. JP03, Sturtevant Div., Hyde Park 36, Mass. ■ **You can be sure... if it's Westinghouse.**

Westinghouse

J-80703

Cut Perfect Gaskets *Easily* with the ALLPAX Gasket Cutter

If you can draw circles with a compass you can cut perfect gaskets in seconds with this handy kit. Just set the blade for the desired thickness, set the pivot post at the desired diameter, and a smooth swing of the cutter gives you a clean, accurate gasket . . . from a ¼ inch bolt hole to a 60 inch outside cut. Larger diameters can be cut with additional extension arms.

The ALLPAX Gasket Cutter is packaged in this strong steel case.

The ALLPAX Gasket Cutter has become standard equipment in thousands of plants where expensive "down time" is kept at a minimum by cutting new gaskets when and where they are needed. Available in five styles to cut maximum diameters of 12, 24, 36, 48, 60 inches.

Use the following Allpax gasket materials for your gasket requirements:

400—Compressed Asbestos Sheet
500—Superheat Compressed Asbestos Sheet
600—Vegetable Fiber Oil Proof Sheet
700—Red Rubber Sheet
750—Black Rubber Sheet
800—Diaphragm Sheet
850—Cloth-Inserted Sheet

ALLPAX
"The Packing that Packs All"

SEND FOR OUR NEW CATALOG — TODAY!

A complete line of packing, tools, gasket materials
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THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

Electrical application

Begins on page 289

640 **Lighting equipment,** firm's complete line, is described in 28-p condensed catalog. Price list included. Steber Mfg Company

641 **Footcandle-** and lighting-design booklet A-7235 is pocket-sized manual. Westinghouse Electric Corporation

642 **Value of floodlighting** is discussed in 10-p bulletin GEA-7201. Application data on filament, mercury-vapor and fluorescent units is given. General Electric Company

643 **Area floodlighting**—discussed in informative 16-p booklet 2719. Crouse-Hinds Company

644 **Emergency floodlighting** is topic of 10-p catalog. Stonco Electric Products Company

645 **Radiant heaters** are covered in catalog GC-106. Features baseboard, wall-panel, ceiling-recessed glass, electric units. Berko Electric Manufacturing Corp

646 **Rheostats,** carbon-pile, screw drive and switchboard types, are covered in well-illustrated 12-p booklet. Specs and selection info given. James G Biddle Company

647 **Ac test sets,** h-v console type, are topic of 4-p bulletin GEA-6839—for dielectric testing of insulation, components and apparatus up to 50 kv. General Electric Company

648 **Dc test set,** portable, high-voltage is featured in spec sheet 5-1.3. Associated Research Inc

649 **Hook-on volt ammeter** for testing ac voltages is described in 4-p bulletin GEA-6292C. General Electric Company

650 **Instruments for generating** plants, distribution areas, substations and electrical testing are topic of 12-p brochure GEZ-2975. General Electric Company

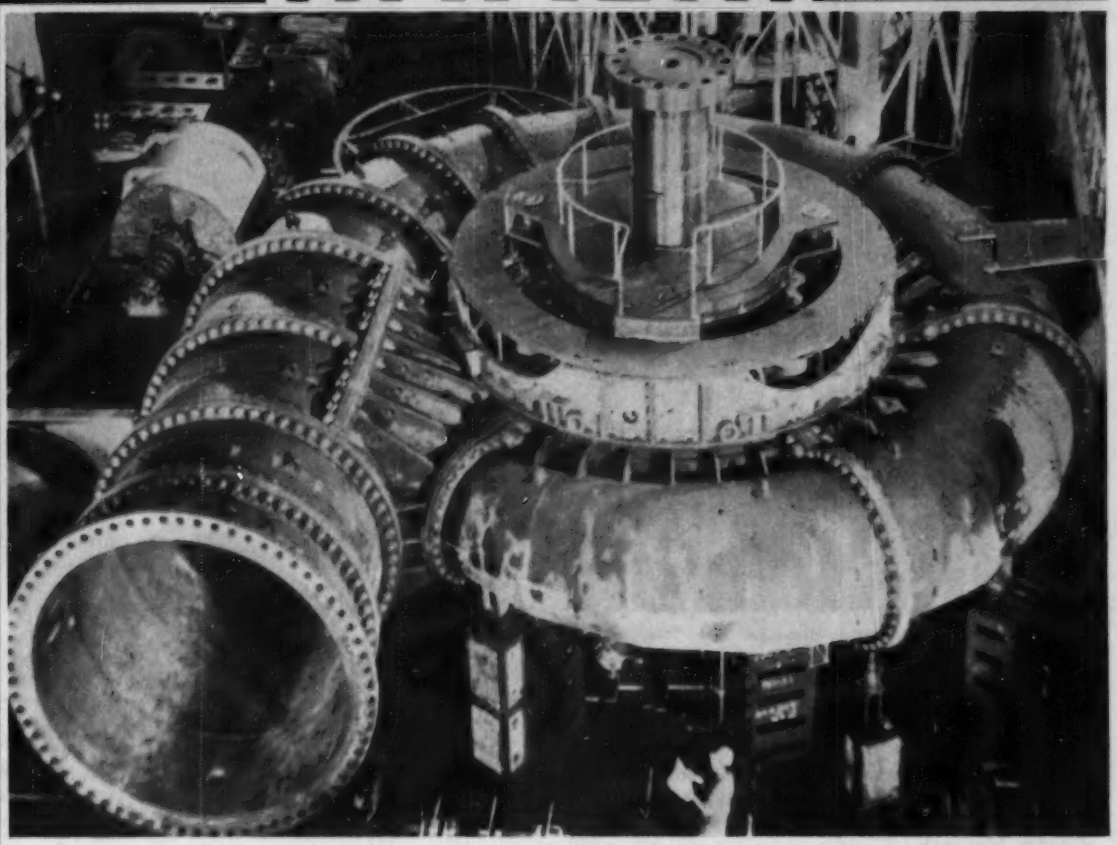
651 **Induction motors** are topic of application and buying guide GEC-1049. General Electric Company

652 **Dripproof totally enclosed** polyphase squirrel-cage motors for close-coupled centrifugal-pump applications and 1/16 to 10-hp motors are covered in bulletins. Wagner Electric Corporation

653 **Vertical motors,** solid- and hollow-shaft types rated 150 hp, frames 584 and larger are featured in comprehensive 164-p bulletin 219. Ideal Electric and Manufacturing Company

654 **Heavy-duty** synchronous motors and variable-speed vertical magnetic drives are described in spec sheets. Electric Machinery Mfg Company

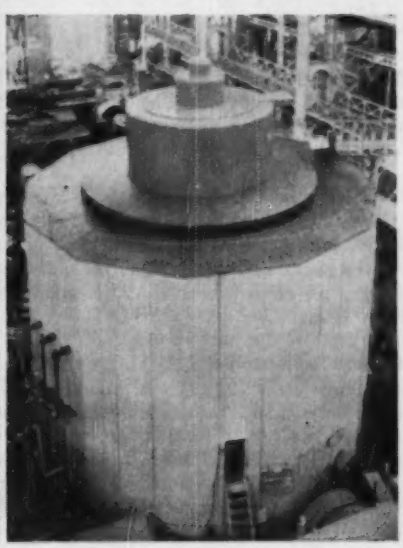
HITACHI



Another big Hydraulic Turbine and Generator by Hitachi

Hitachi has recently completed two 137,500kw/125,000kVA hydraulic turbines and generators for the Miboro Power Station in Central Japan.

The turbine is of the vertical-shaft Francis type, and specified for a speed of 225rpm, a maximum effective head of 200m and 76.6 cu.m/sec water flow, making it one of the largest units of its kind in the world. Its runner has a maximum diameter of 3.7m and the main shaft a diameter of 95cm. The spiral casing, which was constructed in 13 sections to facilitate transportation to the site, has an inlet diameter of 3.35m and an outer diameter of 11.2m.



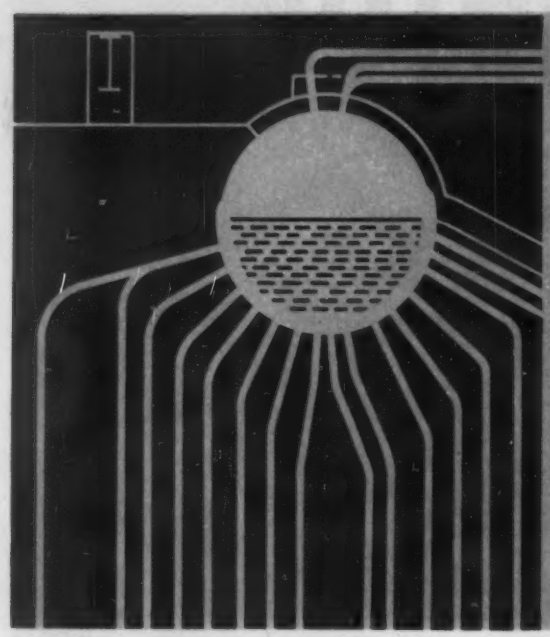
The generator presents a high-torsoed appearance as shown in the photograph, having been so designed in consideration of the comparatively high speed. Since the generator was designed for a rated voltage of 16,500 volts and, in this respect, represents the first such attempt in Japan, particular care was taken in the corona-shielding and impulse resistance of the stator winding.

The generator is rated at 60 cycles, 225rpm and 0.9 power factor but is also capable of operating at 50 cycles, 187.5rpm and 1.0 power factor.

Hitachi, Ltd.
Tokyo Japan
Cable Address: "HITACHY" TOKYO

For more facts circle 947 on Reader Service card, p 207

STEAM AND HOT-WATER SYSTEMS



Packaged steam generators continue to handle a major portion of total industrial load for heat or process use. Packaged units are presently capable of handling loads up to 120,000 lbs per hr at efficiencies rivaling field-erected equipment. Credit for these high efficiencies goes to packaged air heaters and economizers tied to the base steam generator.

High-temperature hot-water and thermal-liquid generators continue to pick up followers in industrial applications where uniform temperature is important. Thermal-liquid units find greatest favor where high temperatures are needed since low-pressure operation, even with costlier fluid, balances cost of high-pressure systems.

Special flash generators make system flexibility possible even in lower capacities by lowering pressure needs of main system.

L. E. Stuart

Associate Editor

● Boilers, burners, heaters

213 **Boiler** designed to burn gas, light oil or gas and light-oil combinations offers firing and controls for most heating and process loads in 800 through 3500 lb per hr range. Efficient fuel economy is in part obtained from fiber-glass insulation for cutting heat losses and front-head air cushion for cool, clean combustion air of predictable density and volume. Four passes maintain high gas velocity. Hot water, steam units are available.—Cleaver Brooks Company

214 **Automatic packaged-boiler** series includes models for light-oil, natural-gas or combination gas-light-oil operation. F-d units have compact 3-pass design. Single motor drives both fan and oil pump.—Western Boiler Company

215 **Indirect-gas-fired heater** for storage water has "localized" combustion unit and fluid-to-fluid intermediate heat-transfer system for scale-free heating. Self-contained package includes electronic controls for safe, quiet, automatic operation, consists of three integrated systems: gas burner or furnace; forced-circulation heat-transfer system with firetube element, hot-water-heating bundle and interconnecting piping; shell section for heating, storing and temperature control of service water.—The Patterson-Kelley Co, Inc

216 **Heavy-duty finned-tank heater** was designed especially for corrosion problems in plants that must use poor-quality steam. Unit has pressure rating of 600 psi at 650 F, with vertical or off-the-floor design.—Brown Fintube Co

217 **Boiler-return system** maintains positive differential between steam supply and return lines. Condensate and air are quickly evacuated from steam line. Steam requirements are reduced because condensate usually returns to steam generator within 10 deg of saturated-steam temperature. System consists of receiver tank for condensate, two 2-stage pumps, differential valve, piping, remote control panel. Boiler range is 3500 to 70,000 lb per hr.—Stickle Steam Specialties Co

218 **Fan-air gas burner** has input capacity from 100,000 to 3,500,000 Btu per hour. Features: low cost, opportunity for furnace, boiler, process-equipment conversion. Operating with air from low-speed fan, junior-sized burner has removable gas jets which atomize unrestricted air and metered fuel supply in each of four ports. Instant combustion of gas-air mist close to burner permits clean burning, fuel savings.—The Mettler Co, Inc

219 **Gas-conversion burner** changes from oil to gas, including liquid propane. Feature is adjustable venturi which telescopes from 6½- to 13½-in. Unit fits 95% of all existing furnaces, according to manufacturer, delivers 50,000 to 225,000 Btu.—Barber Manufacturing Co

220 **H-t boiler-feeder system** preheats and feeds makeup water, removes air, precipitates impurities and recovers flash steam. A gravity-flow system, it needs no steam or motor-driven pump, saving you $$ during operation and boosting plant efficiency.—It's ASME approved. —H T Boiler Feeder Co

221 **3-pass automatic boilers** rated 1725-, 4312-, 5175- and 6900-lb steam per hr at 124 psi are said to provide unusually quiet operation. Gas-fired units use manufactured, mixed, natural or l-p gas, come equipped with newly designed burner. Blower supplies combustion air, eliminating need for anything but a short stub stack to remove flue products from the boiler room.—Eclipse Fuel Engineering Co

● Controls and maintenance equipment:

Reader Service card, p 207, brings details

222 **Master controller** is a fully automatic, heavy-duty sensing and controlling instrument for use with automatic combustion-control systems, comparable industrial applications. It responds to minute changes in pressure or temperature, transmits line-voltage signals to other system components for control of firing rate, damper positioning, valving or other regulation. Models for controlling steam pressure are available in standard ranges of 0 to 30, 20 to 100 and 75 to 300 psi—ranges above 300 psi on special order.—Cleveland Controls, Inc

223 **Boiler-water gage** operates up to 3000 psi. It uses principles of light refraction: water level is black, steam space shows in clear contrast as a brilliantly lighted line. Gage has single steel chamber with front and back ports covered with circular borosilicate glass protected by mica shield. Gage may be turned at any desired angle.—Jerguson Gage & Valve Company

224 **Ignitor control** automatically fires up network of gas burners in furnaces, boilers and heat-treating systems. Features include high-speed ignition (firing up 32 burners within three sec), positive-contact-wiper switching design which has long life, eliminates arcing gap and wasted energy, according to maker. Operates at 5000 or 6000 v.—Protection Controls, Inc

225 **Pyrometer-calibrating set** was designed for versatility and precision to permit accurate calibration of any two optical pyrometers. Totally packaged set comes ready to use, certified by the National Bureau of Standards. Wide filament-strip lamp can be adjusted by step and vernier rheostats to any desired range from 1400 to 4200 F.—Pyrometer Instrument Co, Inc

226 **Simplified analyzer** needs no chemical reagents or training to operate in connection with oxygen, carbon-dioxide and carbon-monoxide combustion tests. In minutes Analgraph quantitatively determines combustible gases and vapors. Unit is particularly suited for chemical-process work and leak detection. You can sample continuously.—Gas Purifying Materials Co, Inc

227 **External pilot-operated valve** meets requirements for most steam-pressure-reducing installations. Valve includes stainless-steel-ball inner valve closing against a monel-seat ring to withstand wire-drawing effects of steam. Flow is streamlined by tapered opening between inner valve and beveled seat ring. Valve diaphragm is stainless steel for use with higher pressures and temperatures. Sizes range from ¾ to 4 in. Comes in bronze, semi- or cast-steel body.—Klipfel Valves, Inc

228 **Steam trap** offers bellows within a bellows. Double-bellows construction of thermostatic-modulating trap balances closing force of valve being held in the seat. Forced balance allows outer bellows to move only in relation to steam in the trap. Without steam, bellows moves valve off seat to any point necessary to modulate incoming condensate. Lightweight trap has same orifice for pressures to 150 psi.—The C E Squires Co

229 **One-piece cage replacement** unit for thermostatic traps up to 250 psig has seat plug of universal-jointed stainless-steel ball, factory calibrated and preset in unalterable alignment. Monel cage protects bellows from erosive condensate flow. Replacement is simple —remove trap cover, remove worn pieces, insert new unit and re-cover.—Barnes & Jones, Inc

230 **Hydro-volute scrubber** boasts high efficiency, wide range to tackle most dust, fume or odor problems. Scrubber vortexes gas flow in a series of chambers, has shown efficiency up to 99% on materials as fine as flyash. Swirling action within each chamber scrubs gas with water, wets dust particles and centrifuges them out of gas stream.—Johnson-March Corp

231 **Impulse steam trap** No. 130 handles light-condensate loads, steam pressures from 8 to 600 psi. Features are no separate strainer or blowdown valve; only two connections.—Yarnall-Waring Company

232 **Silicon-rectifier-conversion** units help eliminate maintenance of mechanical rectifiers and replacement of tube type rectifiers on electrostatic-precipitator power supplies. For use in h-v dc power supplies on electrostatic precipitators that collect flyash and dust particles. Unit consists of silicon-rectifier diodes immersed in oil and enclosed in an insulating cylinder. Available for use with rectifier transformers rated up to 75,000-v rms and up to 45 kva in full-wave bridge rectifier circuits.—General Electric Company

233 **Rapper** for electrostatic precipitators and dust collectors has 1-piece design to cut maintenance headaches. Unit is made without assembly bolts to stretch, shear or leak air. Exhaust parts on both sides of housing keep vibrator piston centered, cutting housing wear.—National Air Vibrator Co

234 **Cleaner** is said to reduce time for cleaning boiler-preheater tubes. It consists of air- or water-driven motor, sliding-pin expanding head and a carbide drill point. Needing very little headroom because motor is attached to flexible hose, tool can be fed through entire tube without stopping.—Elliott Co, Roto Plant

235 **Liquid soot remover** can be sprayed into hard-to-reach boiler areas. It adheres to soot on vertical and horizontal surfaces, lowering carbon's combustion point. When ignited with a paper torch, carbon burns away rapidly but not violently—and so thoroughly that you may not have to vacuum, according to the maker.—Parke-Hill Chemical Corp

● Fuels and fuel handling

236 **Fuel-oil additive** 7D-24 eliminates fireside accumulations of soot and slag, maker claims. Metering systems for using additive directly in fuel stream are provided. Additive has been field tested.—Nutmeg Chemical Company

237 **Automatic coal scale** has 1000-lb capacity. Eight access doors permit quick removal of weigh hopper and easy inspection of any part. Special linings and mountings keep coal dust *in* when you open the door. When weigh hopper is loaded almost to preset weight, it

comes toward balance, actuating switches, contactors and a solenoid to stop belt feeder and discharge coal from hopper.—Richardson Scale Company

238 **Long-stroke air vibrator** for coal-handling operations dislodges arched material with a direct-timed long-piston stroke. Vibrator has 1-piece design to cut maintenance downtime and repairs. Piston is only moving part. Unit can be used under extreme-moisture conditions and where magnetic dusts exist.—National Air Vibrator Company

239 **Electric vibrator** with water- and dust-tight construction is especially applicable to outdoor bins—said to move stubborn materials from hoppers to conveyor belt in an accurately measured stream in any weather. Model is totally enclosed with built-in ac motor. It uses rotating eccentric-shaft principle to develop vibration, has no pulleys or belts.—Cleveland Vibrator Company

240 **Pneumatic bunker cushion** exerts positive-displacement force of 56,000 lb to fight flow stoppages caused by funneling, bridging, caking in bins and hoppers. Rubber diaphragm bolted to reinforced-steel base measures about 31x39 in. when installed and reaches operating height of 15.75 in. Rubber shock cords connect membrane and exhaust valve for best mechanical control, prevent deflation before cushion reaches full height.—Tressler Engineering Products Div

241 **Conveyor holdback** protects workers and equipment from dangerous reversal of conveyors and elevators. With installation of unit on the head shaft, conveyor or elevator can be stopped at any time without danger of load traveling backward, says maker. When power is interrupted, rollers wedge between drum and wedge-plate, prevent reversal without appreciable shock.—Stephens-Adamson Manufacturing Company

242 **Belt cleaner** is a row of thin, spring-steel wiper blades with individual pressure springs to catch dirt from conveyor belt as it moves along blades. Pivoted connections between overlapping blades let them fit uniformly against belt and clean evenly. Cleaner is said to remove material which would otherwise be ground into belt and to eliminate messy dribble.—Stephens-Adamson Manufacturing Company

243 **Permanent magnet pulleys** with diameters up to 48 in. are offered for heavy-duty tramp-iron removal and cobbing applications. Made of barium-ferritic-ceramic magnet material, pulleys are said to meet performance of electromagnetic types.—Stearns Magnetic Products

244 **Dry-storage hopper activator** starts reliable flow of dry materials. Mechanical vibrating and pneumatic mechanisms apply to any size hopper. Vibrating shaft has attached vibrating arms centered vertically from base to top of hopper. When materials do not respond to vibration, pneumatic aspect takes over. Vibrating assembly is mounted on air cylinder which moves up and down through material.—Vibra Screw Feeders, Inc

245 **Pendant float** operates a sensitive switch to regulate level of material in bins. Rising level of material tilts float ball. Switch then shuts off current and stops conveyor, elevator or pump. Float returns to vertical position when level falls, switch closes and feed resumes. Control prevents choking and damage.—Stephens-Adamson Manufacturing Company

246 **Belt is a strip of carbon steel** trued and flattened for conveyor applications. Major advantages in handling coal are long life and ease with which coal is scraped from hard, smooth surface (life expectancy: about three years). Movable, plow type scraper discharges coal from belt to furnace. Belt is 16-in. wide, .036-in. thick.—Sandvik Steel Belt Co

247 **Self-clearing coal conveyor** has 2-way switch-controlled motor drive which makes it possible to eject obstructions by reversing coal-screw rotation. Screws and housings are made in matched sections, can be assembled to operate at any angle, with single or dual discharge chutes. Standard capacity: 2500 lb per hour based on 48-lb coal.—Clark & Bobertz, Inc

248 **Conveyor belting** has rubber friction surface, for use where woven duck or stitched canvas is now used. Extra-thick skim coats of natural rubber check wicking and block edge ravel. Belting has a nonstaining surface, is resistant to mild acids. It's bright orange in color.—United States Rubber Company

249 **45-deg idler** design increases carrying capacity. Equipment is narrower and thus saves space, also saves initial cost since loads previously hauled on wider belts can be handled. According to manufacturer there is less spillage, less wear on the belt.—Raybestos-Manhattan, Manhattan Rubber Div

250 **Conveyor carrier** is said to provide true catenary suspension for conveyor belt under all load conditions—features high-tensile spring-steel dead shaft which mounts mild-steel trunnion and shock-absorbing compression spring. Carrier supports belt in natural arc, efficiently training belt and reducing wear.—Stephens-Adamson Mfg Company, Standard Products Div

• Boiler, hot-water-generator design aids: Reader Service card, p 207, orders your copies

655 **Recirculated gas** and its relation to boiler design and operation are topics of 16-p bulletin G-96. Method for properly proportioning heat within a steam generator is featured. The Babcock & Wilcox Co, Boiler Div

656 **Packaged steam generators** with combination-firing capacities up to 60,000-lb steam per hr, pressures to 600 psi are covered in 12-p bulletin. E Keeler Company

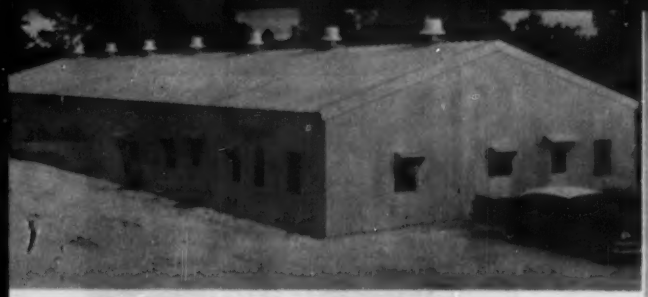
657 **Packaged firetube boilers** are discussed in 12-p brochure. Covers boiler standards, design trends, operation, ratings, factory tests. Cleaver-Brooks Company

658 **Watertube boilers,** water heaters and applications are covered in 4-p bulletin 4011. Units are portable. Vapor Heating Corp

659 **Packaged automatic boilers** are described and illustrated in 4-p brochure. Oil, gas and combination gas-oil models available. Orr & Sembower, Inc

660 **Forced-draft square-heat** packaged boiler-burner units for oil,

Circle 948 on Reader Service card, p 207 ▶



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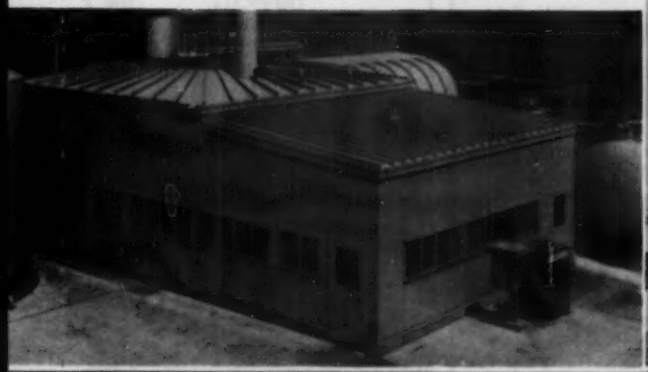

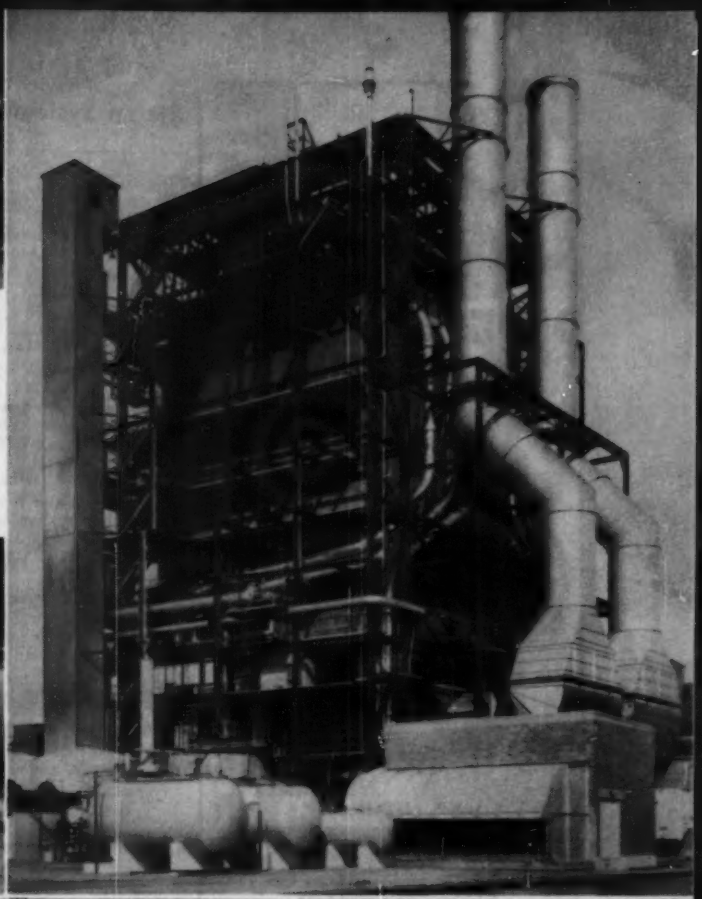

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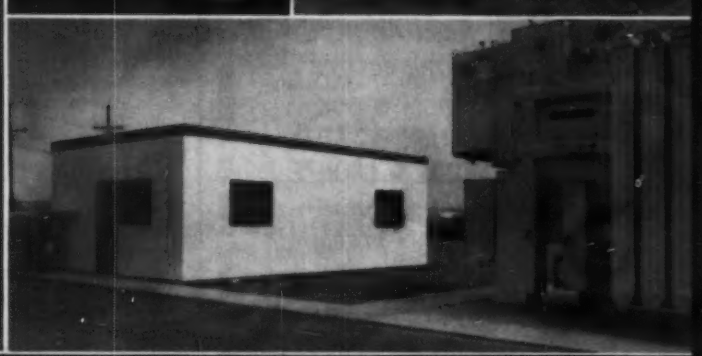

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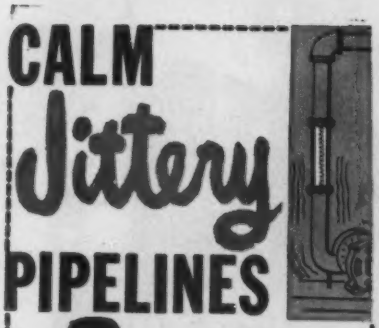

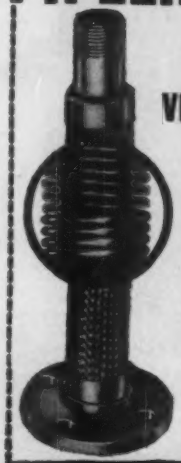

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Steam systems

Begins on page 296

gas or combination firing are detailed in 4-p form 1145. American-Standard Industrial Div

661 **2-drum** oil-, gas- or coal-fired watertube boilers are featured in 20-p new-product catalog SB-57R. Erie City Iron Works

662 **Stoker-fired** packaged steam generator is featured in bulletin PG-59-4. Foster Wheeler Corporation

663 **Power and heating boiler,** 3-pass with all-wetback construction, is topic of bulletin B-3240. Titusville Iron Works Company

664 **Correct procedure** for removing boiler from line is topic of booklet describing new methods. Betz Laboratories, Inc

665 **Waste-heat boilers** are topic of bulletin 1700. International Boiler Works Company

666 **HTHW generators** are described in 16-p brochure 1600 which explains LaMont principles of forced recirculation. Boiler diagrams of installations are included. International Boiler Works Company

667 **Storage water heater,** indirect gas-fired type, is topic of 4-p bulletin 4. The Patterson-Kelley Company, Inc

668 **Wall deslagger** for cleaning boiler, superheater and reheat-section walls—topic of 4-p bulletin 1066. Copes-Vulcan Div of Blaw-Knox Company

669 **Heating coils,** standard-steam, hot-water, steam-distributing and double-distributing types, are featured in 32-p handbook HC-102. Specs, air-friction and temperature-rise charts are included. American Air Filter Company, Inc

670 **Heavy-duty coils** for steam distribution are featured in 44-p brochure B-1518. Discusses materials and construction, layout drawing. American-Standard Industrial Div

• Controls

671 **Thermocouple probes** to measure furnaces and flue-gas temperatures to 3100 F are discussed in spec sheets 8, 8.3. Aero Research Instrument Company, Inc

672 **Draft regulator,** electric-power unit for combustion and process control and master regulator for boiler-steam-pressure control are topic of bulletins H-109, H-110, H-111. Rimcor Products, Inc

continued

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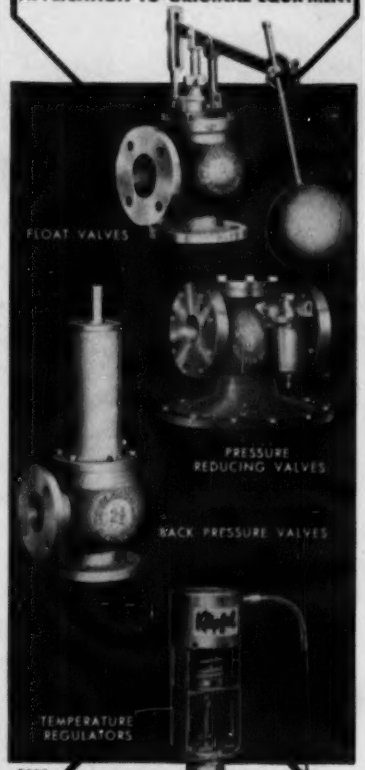

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Steam systems

Begins on page 296

673 **Pneumatic flyash-disposal** methods are detailed in folder ER-49-3. Fuller Company

674 **Flyash-control system, "wet-water"** type, is explained in 4-p folder 66B. Deynor Corporation

675 **Boiler safety device** combines float action and electrode-operated functions. Details in catalog section D2.5. The Reliance Gauge Column Company

676 **Water-control systems** for steam boilers are presented in illustrated brochure. Performance tests, maintenance costs included. Sparkler-Filtrion Corporation

677 **H-t boiler feeder** is feature of 12-p bulletin. Operating principle, application range, sizes, dimensions and weights, ordering info are given. Chart aids selection. H T Boiler Feeder Co

678 **Impulse steam traps** are topic of well-illustrated 8-p bulletin. Various models handle regular, light and extra-heavy loads. Yarnall-Waring Company

679 **High-pressure** and **-temperature** valves for general boiler-room use ar pictured in 12-p bulletin. Photos show typical installations. Yarnall-Waring Company

680 **Unit-tandem blowoff** valves for boiler pressures up to 665 psi are topic of 4-p folder. Features are listed, and a section tells how to order the medium-pressure units. Yarnall-Waring Company

• Fuels and fuel handling

681 **Reference chart** to facilitate ordering grades of coal gives info on where it's produced, shipping facilities and sizes made. Eastern Gas and Fuel Associates

682 **Fuel-oil additive** 2 is ashless, nonmetallic, contains copolymer. Details in 12-p bulletin FOA-2. E I Du Pont de Nemours & Co, Inc

683 **Fuel-oil conditioner** 7D-24 with Disotrol helps prevent fireside accumulations. See 4-p brochure from Nutmeg Chemical Company

684 **Selection** of electromagnetic pulleys or nonelectric type—explained in catalog C-2000. Dings Magnet Separator Company

685 **Weighing-system** fact folders for collection of competitive data provide info on "rolling-ball" head and instrumentation. The A H Emery Company

continued

DESIGNED FOR STEAM TURBINE TESTING

TYPE WG DEAD WEIGHT PRESSURE GAGE

Please request data sheet 593

MANSFIELD & GREEN INC.
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circle 957 on Reader Service card, p 207

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As a public service to those in business and industry who are responsible for the protection of lives and property from the hazards of fire

FIRE RESISTANT INCOMBUSTIBLE FLAME RETARDANT

FIRE PROOF PROVE IT! FLAME-PROOF NON-FLAMMABLE

MATERIALS FOR PROTECTION OF THERMAL INSULATION AGAINST FIRE DAMAGE

FIRST, to clear up a common misconception about materials used to protect thermal insulation; no coating, sealer, or adhesive can by itself prevent fire damage. In fact, certain products without fire-retardant properties many times will actually cause fire and flames to spread; while products containing fire-retardant properties can at best only retard the spread of flames by the reduction of available fuel.

Over the years many ambiguous and ill-defined terms have been used to describe fire resistant properties of materials in literature, specifications and other published data. Words and phrases such as incombustible, flame-proof, non-flammable, fire resistive, and even fireproof have been attached to products used for the protection of thermal insulation. In many cases where the use of these terms was based on unrecognized and inadequate test methods, the products actually fed fuel to the flames rather than retarding them.

The only accepted measure of fire hazard in coatings is the flame-spread value. The confusing phrases used above do not give in exact terms the flame-spread value. If the confusion is to be eliminated, Industry must adopt a standardized system of testing and terminology for use in Engineering Specifications.

The use of confusing terms can be discarded by the adoption of the rating standard known as the Flame-Spread Index, accepted and used by building codes and insurance underwriters. There are two test methods accepted by Industry for determining flame-spread values. These are the Underwriters' Laboratories' "Tunnel Test" (ASTM E84) and the National Bureau of Standards "Radiant Energy Test" (Interim Federal Standard .00136–Com. NBS). With either of these established methods, flame-spread values ranging from zero to over 200 can be determined with accuracy for all coatings, adhesives and sealers used with thermal insulation materials.

An example of flame-spread values:

A totally incombustible material such as portland cement would have a flame-spread value of zero, while a self-extinguishable synthetic resin product could be rated about 60, and a violently combustible nitrocellulose product would be rated at "over 200."

Here, also, are the flame-spread values of some popular insulation weathercoatings applied over calcium-silicate insulation:

VAPOR BARRIER ASPHALT MASTIC	
Product A	175
Product B	173
Foster C. I. Mastic 60-26	170
FIBRATED ASPHALT EMULSION MASTIC	
Product A	218
Product B	200
Foster H. I. Mastic 90-07	150
FIBRATED POLYMER EMULSION MASTIC	
Product A	290
Foster Sealfas Mastic	40
FIRE RESISTIVE VAPOR BARRIER MASTIC	
Foster Fire Resistive Mastic 60-60	35

The Solvent Problem

Flame-spread values of solvent type mastic weathercoatings are determined under solvent free conditions to simulate service conditions existing after the products have been applied and all traces of solvent have evaporated. However, during application and cure, a fire hazard will exist when flammable solvents are contained in the coating. Such solvents having a flash point lower than 100° F. are flammable and easily ignited by welding sparks, matches, electrical sparks, cigarettes, etc. Thus a product, whose flame-spread index under solvent free conditions is relatively low, could well be the cause of a disastrous fire while it is being applied if it contains a flammable solvent.

Therefore, for complete fire safety, where welding and other sources of sparks and flame cannot be avoided during application of coatings and adhesives, these products should be chosen not only for their ultimate flame-spread value, but also for their formulation with non-flammable solvents (for example, Foster Fire Resistive Mastics).

Recommendations

We urgently recommend that engineers who specify fire resistive coatings, sealers and adhesives for use with thermal insulation specify maximum acceptable flame-spread values and flash points of materials. Only by rigidly adhering to such specifications will owners, their inspectors, buyers and applicators obtain fire safe thermal insulation construction.

A Word of Caution

The mere publishing of a flame-spread value is insufficient evidence on which to choose a product. Where two products, equivalent in every other respect, are offered for fire safe service, a product with a flame-spread value of 6 should unquestionably be chosen over a product whose index is 44. *Relative* flame-spread values, then, become of vital importance in choosing fire-retardant products.

Purpose

We at the Benjamin Foster Company have been devoting many years to research, study, manufacture and promotion of fire safe products for use in the protection of thermal insulation. We have adopted a firm policy regarding our promotion of fire safe products which is:

"To cooperate with all interested individuals and organizations in the establishing of a standardized system of testing and rating true flame-spread value . . .

To publish information that will be factual and in accordance with accepted practices . . .

To avoid overemphasis of disaster conditions in the promotion of fire safety . . .

To continue our research and development of products with improved fire safe characteristics."

If there is any way we can be helpful to you or your organization in a better understanding of products for use in the protection of thermal insulation, please contact your nearest Foster Representative, or write Benjamin Foster Company, 4635 W. Girard Avenue, Philadelphia 31, Pa.

foster COATINGS · SEALERS · ADHESIVES for thermal insulation

DIVISION OF AMCHEM PRODUCTS

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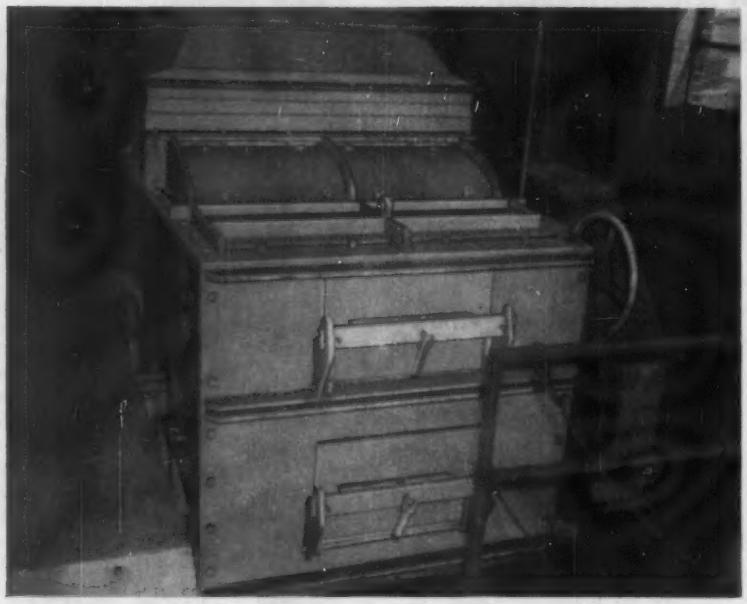

USER REPORT

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The operation record at this municipal power station again proves the stamina and trouble-free performance of American AC Rolling Ring Crushers.

Although reducing ROM coal (up to 6" size) to ¾" this crusher has never needed a part replacement. Over 334,000 tons of coal have been reduced since installation.

The double life of the American-originated rolling shredder ring brought further economy. The rings, which split coal instead of crushing it, are reversible. After four years the rings were reversed to put the unused edges to work. This adds more years to their operational life.

Since 1908, American Pulverizer has manufactured reduction equipment exclusively. Every crusher is custom-built to meet your requirements and ruggedly constructed to give you the lowest possible cost per ton of coal reduced.

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Steam systems

Begins on page 296

686 **Packaged pump and heater** sets for fuel oil are described in 4-p bulletin 15. Data covers units as controls insuring atomization. H Eagan Co, Inc

687 **Belt-conveyor idler** is covered in well-illustrated 20-p bulletin LD-111. Unit is improved version of original 2-bearing catenary idler. Joy Mfg Company

688 **Screw conveyors,** feeders and components are comprehensively reviewed in 76-p book 2989. Application and selection data is included. Link-Belt Company

689 **Sectional-belt conveyor** is topic of bulletin 458. Technical data included. Stephens-Adamson Mfg Company

690 **Conveyors, feeders,** vibrating screens, bin-check valves are covered in bulletins 951, 941, 978. Firm's complete line is discussed in 56-p, 48-p and 12-p catalogs. Jeffrey Mfg Company

691 **Chain conveyors,** elevators are topics of new-product handbook 59127 which gives installation, operation, maintenance information. Chain Belt Company

692 **Vibrating feeders,** motorized counterweight type, are featured in 12-p book 2869. Illustrations and descriptions of 60 sizes are given. Link-Belt Company

693 **Car shaker** for unloading open hopper cars is topic of leaflet 26B9538. Unit weights 3½ tons. Allis-Chalmers Manufacturing Co

• Burners and firing

694 **Automatic firing equipment** is detailed in 12-p well-illustrated booklet 6260. Iron Fireman Manufacturing Company

695 **Gas burners** with capacities from 100,000 to 3,600,000 Btu per hr are announced in 4-p catalog G-100-B. The Mettler Company, Inc

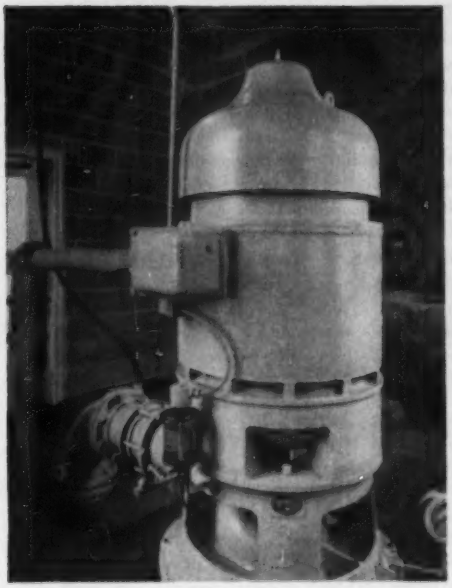
696 **Fuel - burning** and auxiliary equipment is covered in 12-p catalog 6260. Selection of fuels and types of drafts included. Iron Fireman Manufacturing Company

697 **Inshot and upshot** venturi burners with Btu range from 5000 to 400,000 depending on application are covered in spec sheet. Barber Manufacturing Company

Just circle key numbers on Reader Service card, p 207, to get complete story

"We have found Peerless pumps consistently more efficient and longer lasting than any other pump we have used."

Says Joseph Kuranz, Manager, Waukesha Water Utility, Waukesha, Wisconsin



←"Even at our settings (400-500 feet) and with the severe abrasive action of the water bearing aquifers in our hard water area, we plan on getting 10 years service from these deep well turbine pumps before they need maintenance attention. And when we do remove a pump for inspection, we find there is notably less damage from abrasion in the Peerless equipment."

↑ In addition to the deep well turbine pumps, Peerless Type A booster pumps are in use at four stations. Capacities are approximately 1000-1200 gpm against heads of 170-180 feet.

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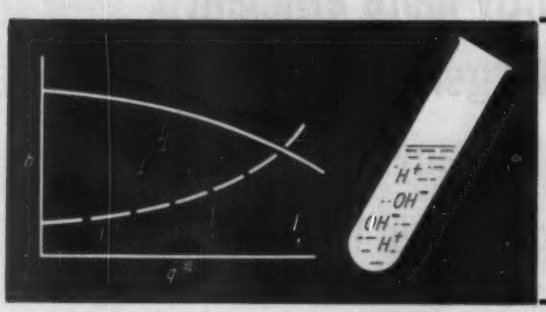
For more facts circle 961 on Reader Service card, p 207

LIQUID-HANDLING SYSTEMS



Solids reduction in boiler feedwater has gone beyond the capability of many older measuring techniques. Recent stress has been on developing more sensitive instruments; now ultrapure waters can be accurately tested and full benefits of solids reduction realized.

New demineralizer resins promise longer operating life.

V. W. Edwards

Assistant Editor

● Water-treatment equipment

251 **Ultrasonic flowmeter** uses high-intensity sound waves for measuring quantity and rate of flow. Meter is expected to resolve problems of field-testing large water meters and checking flow in pipelines and fire-protection systems already in service. Transmitter and receiver attach to outside walls of pipe; nothing goes inside. Meter sends an ultrasonic beam across stream and measures shift of beam under flowing liquid's influence. Transducer sounds echo inside pipe and a fraction of it is picked up by detector on opposite wall. Detector produces small voltage varying with flow velocity; circuits modify voltage according to liquid's density so that both volumetric and mass flow are measured.—Gulton Industries, Inc

252 **Automatic analyzer** monitors insoluble solids but can be modified for solubles, has potential for measuring radioactive fluids. Millipore Filter test method is basis: particles extracted from sample by ultrafine filter membrane leave circular stain on tape for identifying, sizing and counting. You can calibrate discoloration by analyzing a portion of sample and then running another portion through tape analyzer. Millipore tape has effective porosity of 450 millimicrons; it can show concentrations as low as two to four ppb. As trouble-shooter, analyzer pinpoints exact location of solids pickup. You can further test and analyze tape's stain by spectrophotometry, mass spectrography, flame photometry, chemical spot testing.—Graver Water Conditioning Company

253 **Flame photometer** is calibrated for 0.1 to 10 ppb sodium in boiler feedwater. By measuring sodium normally associated with chloride in feedwater, unit measures chloride ion content, will also measure other materials. Flame emits characteristic radiation of impurity in sample. Potentiometer rectifies and measures signal voltage and thus records sample's impurity. —Waters Associates

254 **Cation-exchange resin** keeps whole-bead content approaching 100%—few if any external cracks, according to maker. Resins are in moist sodium form, characterized by extremely hard, tan, spherical particles. Operating capacity of Amberlite 200 is lower than conventional resins, but longer operating life (whole-bead level remained at 100% after treating 1.6-million gal H_2O per cu ft of resin) may compensate for this. Resin is suitable for hydrogen or sodium cycles at temperatures up to at least 250 F, or as acidic resin component of monobed columns. Recommended applications: softening water supplies that cause standard resins to decrosslink, hot-lime-zeolite processes, rejuvenation of plating solutions, mixed-bed deionization.—Rohm & Haas Company

255 **Organic chemical** is practically odorless, nontoxic, nonflammable and noncorrosive for use as descaler and scale inhibitor. Aidco 10 economically de-activates scale on boilers, heat exchangers, condensers, pipelines and refrigeration coils, according to maker. pH is between 9 and 11 and sp gr is 1.14. One gal of formula is added to six gal water and circulated at 160 to 180 F.—Alloy Industries Development Co

256 **Chlorinator** extends simplified stack-regulator design through entire chlorine-control section, improving accuracy, safety and flexibility, says maker. Basic Series-3400 model gives manual or automatic control over capacities from 0.1 to 2000 lb per day. Rigid single-unit glass-fiber cabinet protects against corrosion.—Fischer & Porter Co

257 **Continuous water-sample evaporator** collects, measures water for purity testing. Unit handles as many as one million separate samples in a single, final sample of any desired concentration. Design feature is sample-carrier assembly which continuously guards against contamination. Inlet-water and heater controls interlock to prevent boiling.—Diamond Power Specialty Corp, Electronics Div

258 **Portable pH meter** weighs five lb, features a big scale allowing easy reading of values within .02 pH. Unit operates on 115-v-ac outlet. Model 700 has single operating control, high-output electronically modulated amplifier. Compact housing lets you carry instrument in one hand to use wherever needed.—Analytical Measurements, Inc

259 **Underdrain system** for filters, softeners and ion exchangers consists of plastic disk strainers attached to false bottom. False bottom will not increase rinse requirements, says maker—its greater radius minimizes space between two bottoms. Disk strainers eliminate gravel, anthracite or other inert subfills. Some

advantages of the setup: strainers and fastenings are nonmetallic, design is adaptable for demineralizing units.—Permutit Company

260 **Meter analyzes hardness,** residual chlorine or phosphates through photoelectric-comparison process in colorimetric analysis. Standard range of accuracy: hardness, 0 to 3 ppm; residual chlorine, 0 to 1 ppm; residual phosphates, 0 to 30 ppm. Chemalyzer's indexing motor proportions 0.7-cc reagent feed with fixed sample volume at variable intervals.—Milton Roy Co

Pumps

261 **Centrifugal pumps** range from 1000 to 3000 gpm. Heavy-duty vertical centrifugal sump and process pumps come in 6- and 8-in. sizes for either dry- or wet-pit service. They have iron, bronze-fitted or stainless-steel construction. According to maker, all possible points of vapor or fume leakage are sealed for vapor-proof handling of toxic or hazardous liquids.—Goulds Pumps, Inc

262 **Centrifugal pump for leakproof handling** of volatile, toxic, inflammable or other hazardous liquids has no mechanical seal, stuffing box or gland. Motor and pump are combined in integral unit. Pump capacities range up to 110 gal per min, heads up to 100 ft. Pump has two sizes with 1- and 1¼-in. discharge.—Goulds Pumps, Inc

263 **Diaphragm pumps** are designed especially for high-solid-content water handling and positive control of seepage. Sizes range from 1½ to 4 in. Centrifugal pumps mount on wheels for easy handling in cramped quarters. Models are available with gasoline engine or electric-motor drive.—Hale Fire Pump Company

264 **Metering pump,** ruggedly built, is simple in design. You can use it for many metering applications, particularly handling slurries and viscous liquids of all kinds, says maker. Pump is ruggedly constructed; simple, compact design permits moderate pricing. Gear case and pump body are flanged together, sealed against moisture and dirt. Capacities range from 0 to 10, 18, 36, or 54 gph, pressures to 300 psi.—The Madden Corp

265 **Variable-capacity rotary pump** lets you dial any desired flow rate from zero to full capacity without changing pump speed. Standard-speed motor powers pump. Additional bypass piping and valves for evacuation of discharge lines are not needed because pump will reverse flow while in operation. Applications include filling storage tanks and drums. You can also use pump for liquid proportioning.—Blackmer Pump Company

266 **Control for pump motors** protects 3- to 100-hp squirrel-cage motors that drive oil-well pumps. Controller with 3-phase 60-cycle 220/440-v-ac rating has 3-pole relay for protection against locked rotor, single-phase starting and running and normal overload. It comes with lightning arrester and circuit breaker. Operation is automatic.—Westinghouse Electric Corporation

267 **Small-suction dredge** solves problems of removing mud, silt, sand or gravel from water-supply areas. It is available with 6-, 8- or 10-in. pump, comes with V-belt drive, gas or diesel exhaust primer, your choice of gasoline, diesel or electric-power unit. Complete unit mounts on structural-steel sub-base, has gages, pump fittings.—Morris Machine Works

Trash rakes

268 **Hydraulic rack rake** is for dams, hydroelectric stations where trash removal from water-inlet racks is a problem. Unit has digging action which removes trash from bottom of racks, keeping them clear for their full length. Standard equipment includes power operation for carriage traverse and rake hoistings.—The Portland Co

269 **Mechanical trash rake** cleans debris from racks or screens in front of gates where water is required in large volume—pumping, processing, sewage disposal. It guides, clears, dumps from remote control or differential water level.—Frank W Stuker & Associates

270 **Self-dumping** log-grapple trash-rack rake descends with teeth retracted. There's enough space between rack bars and basket teeth to clear accumulated trash. Going up, teeth engage rack bars, clean trash and dump it into a car. Available in 6- to 12-ft sizes, this rake frees water intakes of branches, boxes, tin cans. —Allis-Chalmers Manufacturing Company

• Water-treatment design aids: Circle key numbers, p 207, for your free copies

698 **Treatment of condensate** by scavenger mixed-bed demineralizers is discussed in reprint 117. Cochrane Corporation

699 **Portable chlorinator** is described in data sheet D-60-1. Milton Roy Company

700 **Fiber-glass tanks** for water-softener applications are described in new bulletin. Apex Reinforced Plastics

701 **Research problems** in production and quality control of ultrapure feedwater for Eddystone Station are covered in reprint. Graver Water Conditioning Company

702 **Priming and foaming** in low-pressure heating boilers are discussed briefly in bulletin 597. Water Service Laboratories, Inc

703 **Water - and liquid - treatment** units, clarifiers and thickeners, are described in new bulletin WC-123 Graver Water Conditioning Company

704 **Modern approach** to cooling-water treatment is topic of new water-conditioning data sheet. Betz Laboratories, Inc

705 **Results of** 3-yr corrosion tests on wrought iron and ten structural steels in salt- and lake-water environments are contained in 12-p report. A M Byers Company

706 **Desilicizer feedwater process** is described in reprint 124. Process reduces silica in boiler feed to less than 0.5 ppm. Cochrane Corporation

707 **High-flow-rate clarifier** with suspended-sludge design is featured in 8-p bulletin CL 158. Illinois Water Treatment Company

708 **Ion-exchange resins,** nuclear and technical grades, are detailed in spec sheet. Illinois Water Treatment Company

continued

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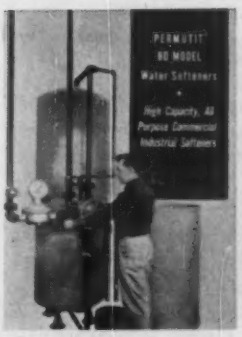
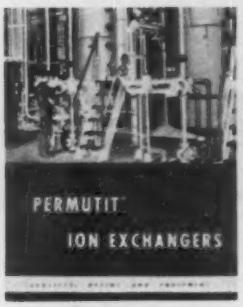


High-capacity water softening: New Permutit® Model BD Softeners answer industry's needs for more soft water at lower cost. Full details on operation, specifications and performance are contained in **Bulletin 4696.**

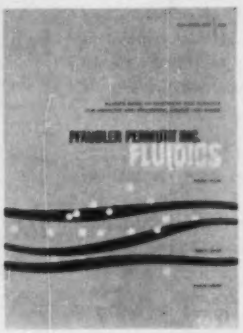
Standard packaged demineralizers: Factory-assembled, systems ready to connect and operate. For summary of applications, plus data on mixed-bed, two-step, non-regenerable and skid-mounted units, send for **Bulletin 4721.**

Automatic valveless gravity filter: Costs up to 45% less than conventional filters. Also saves money after installation, because it operates automatically without a single valve, agitator, pump, flow controller, or an attendant operator. **Bulletin 4351.**

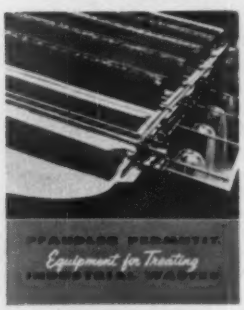


Ion exchangers: From Permutit—the only company to manufacture ion exchange resins and the equipment in which they are used—a manual on ion exchange as a unit process for purification, recovery, addition, separation, concentration. **Bulletin 2508** also covers resins and equipment.

"New" metals for processing: Tantalum, titanium and zirconium are finding increased use because of their exceptional corrosion resistance and strength. Corrosion, heat transfer and general application data on these metals, plus equipment available, see **Bulletin 978.**



How FLUIDICS works for you: Buyer's Guide surveys equipment for water and waste treatment, ion exchange, gas analysis, metering and control. Also equipment for handling corrosives, heat transfer, reactions, centrifuging and packaging. Send for **Bulletin 992.**



Permutit Precipitator: Saves about 50% in ground space, 50%-75% in time of treatment, and 10%-40% in certain chemicals and adsorbents, compared to conventional reaction and settling tank. Complete facts on operation and applications are in **Bulletin 2204C.**

Water treatment chemicals: Permutit offers an extensive line of specialized chemicals. Typical data available: **Bulletin CS-105** on Wisprofloc-20 Coagulant Aid, **Bulletin CS-111** on Neutralizing Amines, **Bulletin CS-110** on the Briquet System.

Deaerating Heaters: Designed for removal of carbon dioxide and oxygen from boiler feedwater. Permutit offers both Spray Deaerators, **Bulletin 2357,** and Tray Deaerators, **Bulletin 4732.**

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Water treatment

Begins on page 306

709 **Sodium-zeolite water-softening** manual 4520 describes process, gives info on selecting, sizing equipment. Cochrane Corporation

710 **Zeolite-softener** care and operation is subject of water-conditioning data sheet. Betz Laboratories, Inc

711 **Cause, effect** and control of water hammer in piping systems, flanged and silent check valves are discussed in bulletins available from The Williams Gauge Company, Inc

712 **Leak testing tanks,** piping is topic of 6-p bulletin GET-2936. Gives detailed instructions on using halogen detectors. General Electric Company

713 **All-plastic pneumatic valve** is described in 4-p booklet. Gives application info, construction details. Illinois Water Treatment Company

714 **Pipeline strainer** for condensate, steam, water, oil, air or gas is topic of 4-p bulletin 1210. Sarco Company

715 **1-piece pipe insulation,** thermal and physical characteristics for below zero to 250 F are covered in 4-p bulletin J-660. Baldwin-Ehret-Hill, Inc

• Pumps

716 **Rotary pumps** change displacement to vary delivery from zero to full capacity while running at constant speed. Specs and application data in 8-p bulletin 600. Blackmer Pump Company

717 **Submersible pump motors** are described in 8-p brochure F-2000. U. S. Electrical Motors Inc

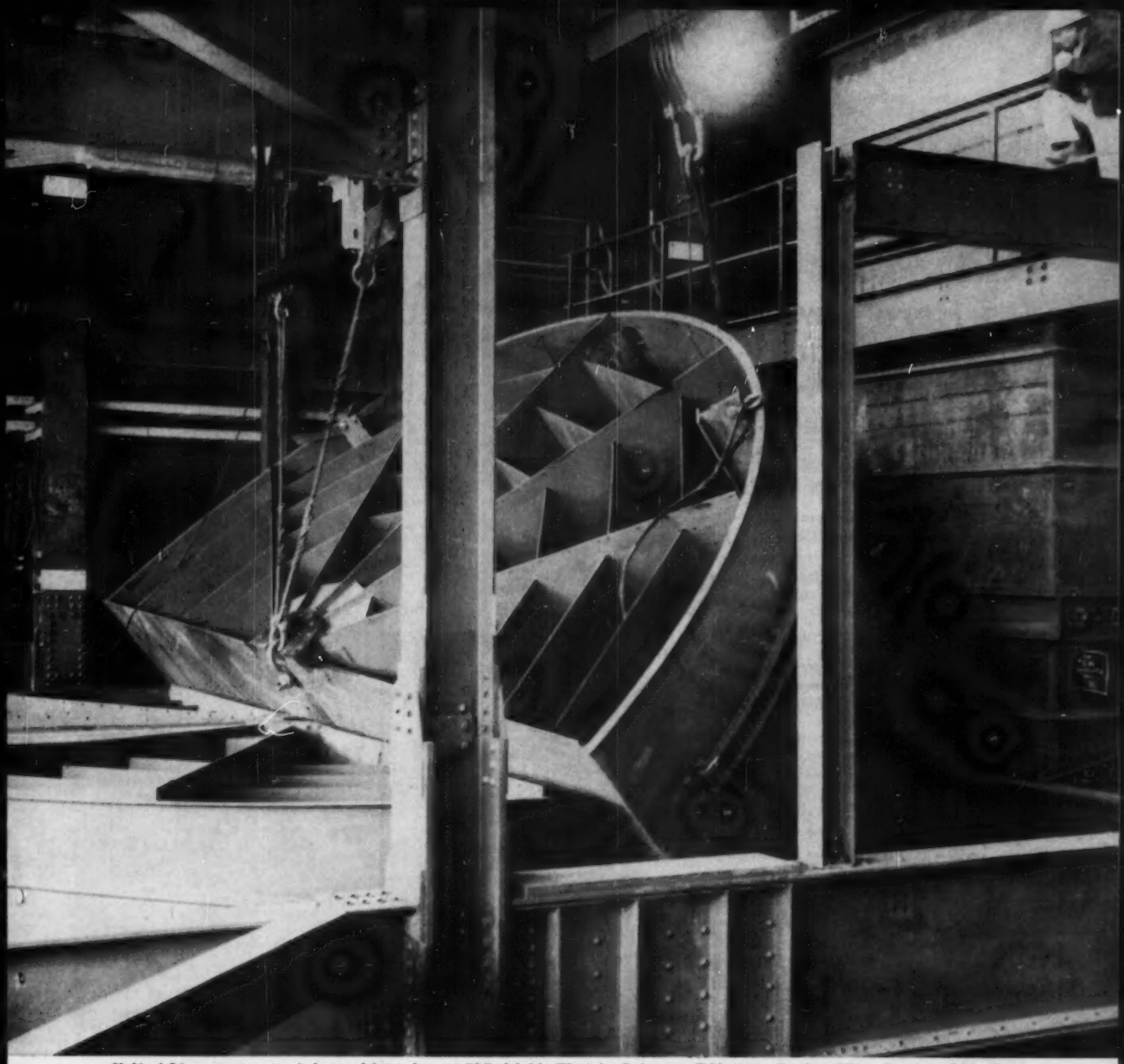
718 **Vertical wet-pit pumps** with capacities to 200,000 gpm are topic of 6-p booklet 7209-A. Ingersoll Rand Company, Hydraulics Div

719 **Slurry pump** with volume from 0 to 180 gph at pressures to 90 psi is detailed in 4-p bulletin 1158. Milton Roy Company

720 **Composite 3-color curve** showing firm's seal-less leakproof pump ranges is offered. Fostoria Corporation, Chempump Division

721 **Turbine type pumps** with capacity range up to 150 gpm, pressures to 300 psi and temperatures to 275 F are described with charts and tables in 8-p bulletin S-111. The New York Air Brake Company, Aurora Pump Div

continued



Half of Ljungstrom rotor is lowered into place at Philadelphia Electric Co.'s new Eddystone Station. When heating element baskets are fitted into the rotor chambers, this unit will provide 201,100 sq. feet of heat transfer surface and will weigh about 535,000 lbs. It will be one of four air preheaters serving a 325,000 KW unit. Two such boiler units are presently being installed.

SAFEGUARDING EDDYSTONE'S **NEW LJUNGSTROMS®** **—LIFETIME AIR PREHEATER SERVICE**

Dependability is standard equipment in Philadelphia Electric Co.'s new Ljungstroms. Each unit is protected by Lifetime Air Preheater Service. That means that *throughout the life of each unit*, Air Preheater engineers make regular calls to inspect the Ljungstroms and keep them in top operating condition.

Air Preheater also shows lively, consistent interest in their *factory* service to customers. For example, when a midwest customer recently ordered emergency replacement elements, Air Preheater's traffic department investigated the cost, speed and control of all commercial shipping methods. In the circumstances, regular trucking would take too long, rail delivery was impractical, other methods prohibitively expensive.

So Air Preheater asked for authorization to ship the replacement elements aboard one of their own trucks. The result: the elements arrived a week in advance of the hoped-for date — and, thanks to Air Preheater's efforts, the customer made significant savings on transportation costs.

In addition to regular field service and fast, competent factory service, Air Preheater offers you over 35 years of experience in solving boiler and preheater problems. These reasons help explain why 19 of the 20 most efficient power stations in the U.S. are Ljungstrom-equipped.

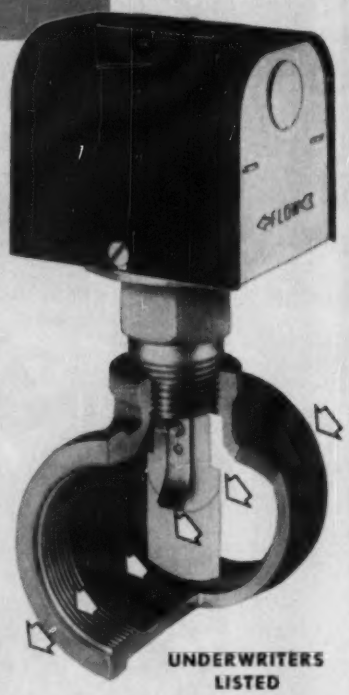
THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more facts circle 963 on Reader Service card, p 207

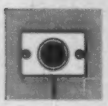
McDONNELL *Flow Switches*

FS4 Series Flow Switch shown mounted in a 2 inch Tee



Here's what they do!

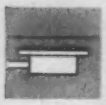
What you see here is a compact, well-built switch that makes or breaks a circuit (as required) when liquid flows or stops flowing. It's an economical and positive way to start or stop anything electrically operated. Just to highlight a few uses:



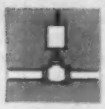
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.

to sound an alarm—when flow stops in a process system or in any water cooled devices.

to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops.



to start or stop automatic burners—start a booster heater when water draw occurs, stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

UNDERWRITERS LISTED

Positive snap action switch. Easy to install and wire. Segmented paddle fits any pipe from 1" through 3". Unit shown handles pressures to 100 psi, temperatures to 300° F., in these types:

FS4-3—SPDT switch. Opens and closes two separate circuits with flow; closes and opens same two circuits with no flow.

FS4—Closes with flow; opens with no flow.

FS4R—Opens with flow; closes with no flow.

NOTE: Model E-2 available for larger pipes, pressures to 150 psi.

McDONNELL & MILLER, *Inc.*
3506 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

Coupon brings bulletin

—covering design, construction, electrical ratings, dimensions, typical applications.

Please send me a copy of Flow Switch Bulletin FS1-A.

Company_____

Address_____

City, Zone, State_____

By_____

Mail to: McDonnell & Miller, Inc., 3506 N. Spaulding Ave., Chicago 18, Ill.

Pumps

Begins on page 306

722 **High-head canned pumps,** 3-stage type, for heads up to 600 ft are described in 4-p bulletin 1030. Fostoria Corporation, Chempump Div

723 **High-vacuum pumps** using the Roots principle are described in 16-p illustrated bulletin S-20. Specs, operational info given. Consolidated Vacuum Corporation

724 **Centrifugal pumps** are topic of folder 670E. Specs included. Fostoria Corporation, Dynapump Div

725 **Metering pump,** electrically driven, positive-displacement reciprocating plunger type handling 0.65 to 2025 gph is introduced in 12-p catalog 420.200. Wallace & Tiernan Inc

726 **Process - water** proportioning pump is featured in spec sheet 1210.20-1. B-I-F Industries, Inc

727 **50th anniversary** brochure displays new products for industrial waste treatment, sewage pumps. Chicago Pump Company

728 **Condensation pump** line is detailed in 12-p bulletin CP-600. American Air Filter Company, Inc

729 **Free-piston pump** with 100-gpm capacity is topic of 4-p brochure. The Crossley Machine Company

730 **Electric - powered** centrifugal pumps are described with specs in bulletin CPE-1-27. Rice Pump & Machine Company

731 **Bronze and iron** centrifugal pumps with capacities up to 320 gpm and pressures to 40 psi are described in 6-p bulletin 1004. Marine Products Company

732 **Seal-less canned pumps** for HTHW heating systems are discussed in 4-p bulletin 5. Fostoria Corporation, Chempump Div

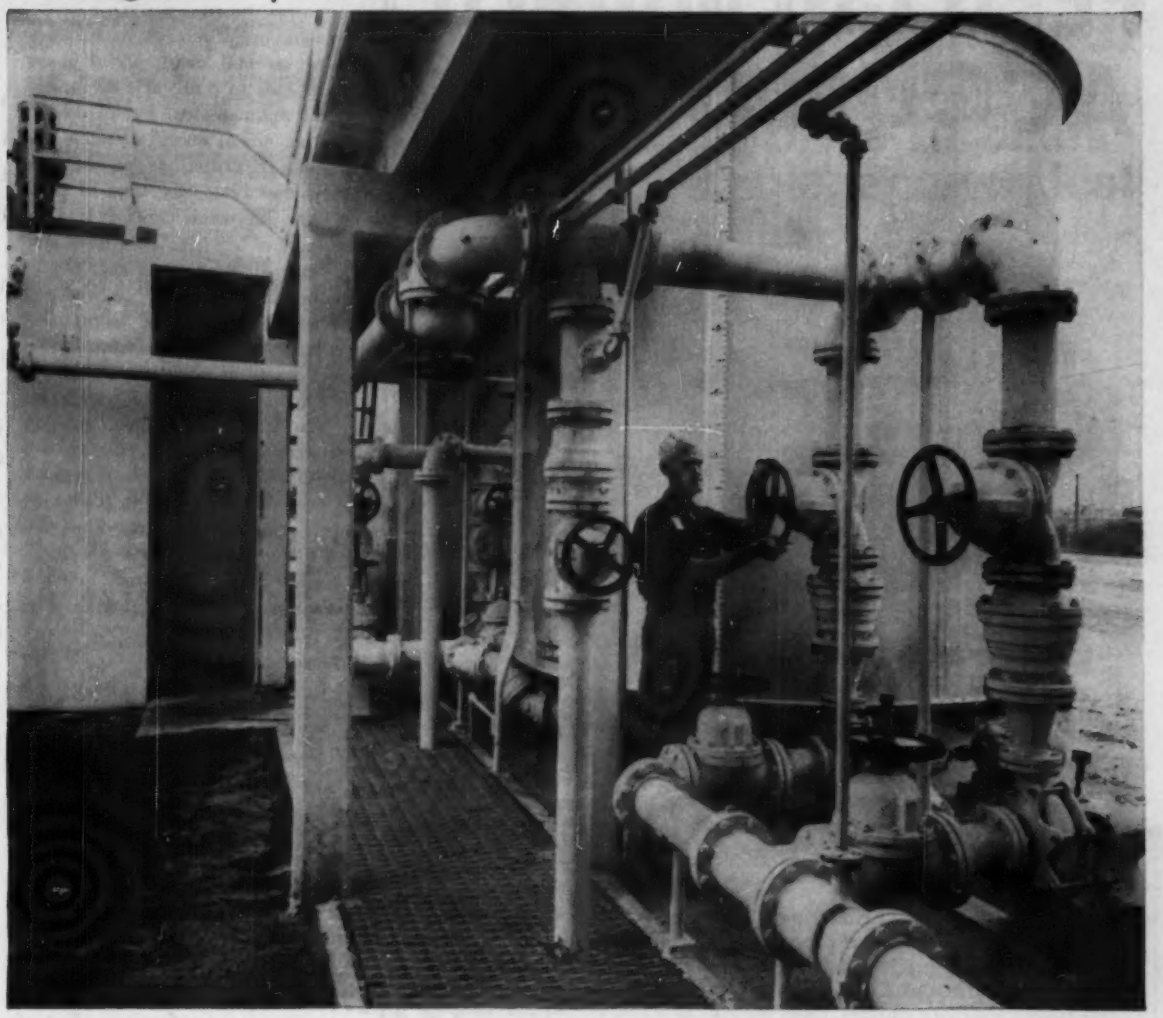
733 **Displacement pump** with 15- to 220-gpm rating, discharge pressure of 100 psi is subject of info sheets. Goodyear Pumps Inc

734 **Pump - tank combination** for chemical-solution feeding, boiler-water treatment is announced in 2-p reference 7253.20-1. B-I-F Industries, Inc

735 **Seal-less pumps** for leakproof handling of volatile, toxic liquids are covered in 4-p bulletin 728.1. Goulds Pumps, Inc

Just circle key numbers on Reader Service card, p 207, to get complete story

DOW | **SARAN LINED PIPE**



After 9,000,000 gallons of heated acids, plating waste ... No Corrosion in SARAN LINED PIPE

When piping and valves carry more than a million gallons a month of heated acid and plating waste solution . . . when failure in the line would peril essential plant operations . . . there can be no guessing about corrosion resistance. The situation calls for Saran Lined Pipe and valves!

Shown above is one of the Saran Lined Pipe installations in use at the Florida R & D Center, Pratt & Whitney Aircraft, Division of United Aircraft Corporation, United, Florida. This installation carries 1,100,000 gallons per month of solutions of chromic acid, hydrogen fluoride, potassium cyanide, nitric acid, phosphoric acid and other chemicals. The solutions are in transfer from the Plating Department to waste treatment areas, at an average temperature of 100°F.

The Saran Lined Pipe and valves were installed eight months ago. Thanks to the extreme corrosion resistance and high mechanical strength of the piping, there's not been a single trace of corrosion or of failure.

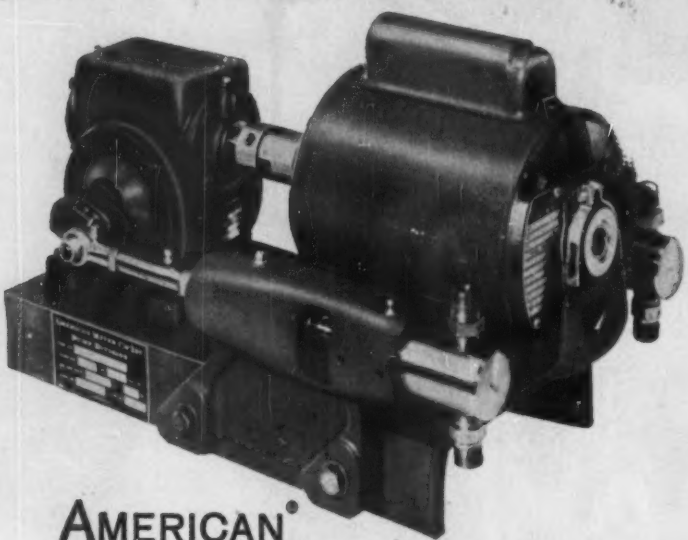
Whenever problems of corrosion and chemical activity are encountered in piping systems, Saran Lined Pipe is your best answer. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200°F. They can be cut, fitted and modified in the field. For information, write Saran Lined Pipe Company, 2415 Burdette Ave., Ferndale, Michigan, Dept. 2289DW10.

See "The Dow Hour of Great Mysteries" on TV.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

For more facts circle 965 on Reader Service card, p 207

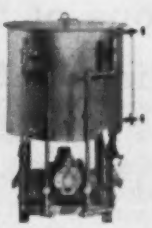
FEED CHEMICALS ACCURATELY!



AMERICAN®
METERING PUMPS

Series 100 pumps have repetitive metering accuracy of plus or minus 1% when operating between the limits of 10% and 100% of stroke length. Design simplicity assures dependable, economical water treatment. Screw adjustment on crank provides easy, accurate stroke regulation for capacities ranging from .65 gph to 13.10 gph at maximum pressure of 1000 psi on Series 100 Simplex model. Duplex models have double that capacity.

- interchangeable liquid ends
- spherical self-aligning bearings on crank and crosshead handle greater radial and axial thrust loads
- crossheads of hardened and ground steel ride on cast iron
- easily adjusted screwed packing glands
- heavy duty reducers
- NEMA frame motors
- nylon dust covers protect bearing surfaces



Available with standard feeder tanks of various sizes.

AMERICAN® METER COMPANY
INCORPORATED (ESTABLISHED 1836)
pump division
13500 PHILMONT AVE., PHILADELPHIA 16, PENNA.

NUCLEAR SYSTEMS

Increasing use of nuclear materials in industry as well as in central power stations aids in more efficient operation and maintenance. Forward looking managers of energy systems can use nuclear radiations as well as nuclear energy to do some of their jobs—measurement, control, tracing, processes, etc. These new tools will repay investigation—you may not be able to use them now, but why not get ready for the future? Continuing experience demonstrates the fundamental safety of nuclear materials as long as common sense safeguards are followed scrupulously; insurance underwriters are willing to cover plants where ordinary caution is exercised. The need for precision in designing nuclear equipment and selecting material has given birth to a new highest-quality equipment and material designation—"nuclear grade." Prepare yourself for tomorrow, learn what nuclear materials can do for you.

B. G. A. Skrotzki

Associate Editor

● Nuclear equipment:

For details circle key numbers on Reader Service card, p 207

271 **Aluminum - iron - nickel alloys** withstand deteriorating effect of high-purity water to 680 F, were tested in both wrought and aluminum-powder metallurgy forms. Latter contains 4.81% iron, 7.03% nickel. During tests, this composition registered least susceptibility to corrosion. Slight corrosion diminished quickly to point defying detection, says maker. Alloys may eventually be used for cladding atomic-reactor uranium fuel rods.—Aluminum Company of America

272 **Transistor Geiger counter** weighing only five oz gives instantaneous radiation warning. Instrument is small enough to fit in the palm of your hand. Worker can slip it into his pocket and always be on guard. Operates on small flashlight batteries.—Gelman Instrument Co

• Nuclear design aids

736 **Firm's complete line** of nuclear instruments and instrumentation-system-design services are outlined in 4-p bulletin GEA-7006A. General Electric Company

737 **Nuclear instruments,** technical services of organization are topic of 26-p catalog 59. Domestic price list included. Nucleonics Corporation of America

738 **Radiation detection** and measuring instruments for research, industrial applications are discussed in 36-p catalog I-60. Nuclear Measurements Corp

739 **Dose-rate alarm,** pocket sized for protection against nuclear-radiation hazards, is described in new bulletin. Controls for Radiation, Inc

740 **Design and construction** of reactors, resources and firm's services are covered in booklet 43B9541—specifically treats research and production facilities devoted to atomic-energy problems. Allis-Chalmers Mfg Company

741 **Fifth anniversary** of firm's commercial atomic progress is celebrated in booklet describing applications of atomic energy. General Electric Company

742 **Nuclear and diesel power** operation are described in 28-p publication. Process involved in making reactors, components, development and experience with a diesel engine are featured. Alco Products, Inc

743 **Control rods** for all reactor applications are detailed in 4-p illustrated bulletin GEA-6609. General Electric Company

744 **"Critical piping** for nuclear age" is title of 24-p brochure describing firm's facilities for fabrication and erection. Midwest Piping Company

745 **Remote-control systems** for nuclear industry are described and illustrated in 12-p catalog. Photos and drawings aid explanation. Teleflex Inc

746 **Inconel heat-exchanger tubing,** nuclear quality, is described in spec sheet STC-107. Superior Tube Company

Just circle key numbers on Reader Service card, p 207, to get complete story

Tightly sealed against heat, cold, dust, fumes, rain, snow . . .

ELLIOTT

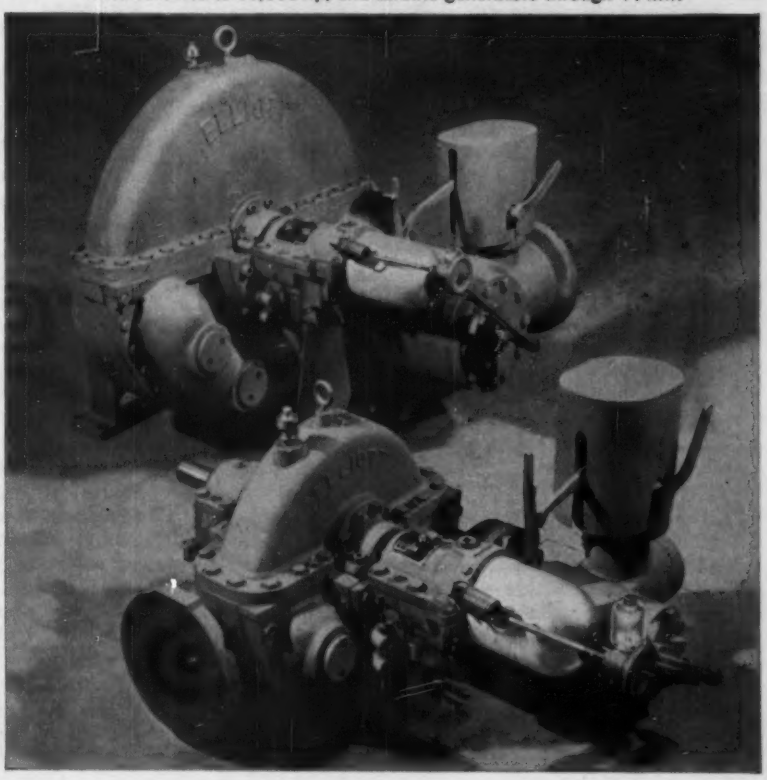
Mechanical Drive Turbines are dependable, economical

Strong and husky, Elliott type YR turbines make dependable, economical drives for pumps, compressors, fans, line shafts, generators and other equipment. All-weather protection assures dependable operation under all conditions of heat, cold, moisture, dust and contaminated atmosphere.

The governor is simple and reliable, and is available in several modifications to match speed and pressure control requirements. YR turbines are designed for easy installation and service. Many key parts are interchangeable for various frame sizes. Two sizes are shown below. Write for descriptive bulletin H 22-D. HO-3

ELLIOTT Company
Jeannette, Penna.

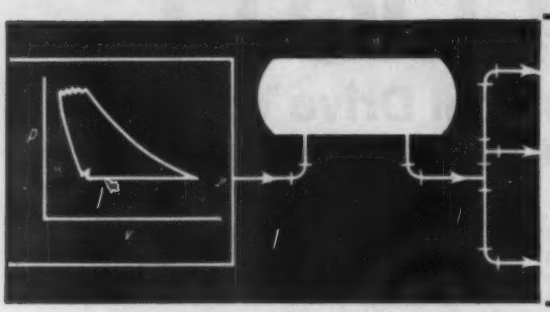
In addition to the units illustrated here, Elliott makes single-stage turbines in special frames, reduction gears, multistage mechanical drive turbines to 50,000 hp, and turbine-generators through 44 mw.



For more facts circle 967 on Reader Service card, p 207

GAS SYSTEMS

For details circle key numbers, page 207



New accessory equipment for compressed-gas systems assures a high degree of operating satisfaction, reliability and safety. Higher-capacity dryers and filters meet more exacting output needs. Meters and leak detectors increase efficiency and cut down waste.

Many new compressor designs have common aim: increased simplicity, reliability and long operating life.

D. W. Edwards

Assistant Editor

● Air compressors:

Reader Service card, p 207, brings full details

273 **"X" shape** dominates new compressor from flywheel to oil fill. Spiral design of intake muffler keeps it silent. Extra-deep closely spaced fins help solve cooling problem. Crankshaft is made of ductile iron with tensile strength of steel—80,000-psi minimum. Crankpin is flame-hardened for wear resistance. "X" shape sets each cylinder at a 45-deg angle from the horizontal, limits rocking motion caused by reciprocating forces acting in opposite directions and producing vibration and wear, according to manufacturer. Ratings: 1½ to 15 hp, 40 to 250 psia, 1750 rpm, 1- or 2-stage models.—Worthington Corporation

274 **No complicated engineering,** special machinery rooms or foundations needed with this new unit, says manufacturer. Compressor is completely enclosed, has no exposed belts or couplings. There are just half the working parts needed by conventional units of similar capacities. Lightweight and compact, compressor is said to run quietly, without vibration. It comes in hp ratings of 20 to 125 and operates at 100 psi—60-in. long, 26-in. wide, 40-in. high, weighs 1600 lb.—Davey Compressor Company

275 **Two-stage rotary compressor** comes assembled. Unit will operate either on floor or mezzanine. All you have to do at installation scene is add motor, air and water piping. Small number of parts cuts maintenance time and costs. Compressor line covers capacities from 279 to 3300 cfm and discharge pressures to 125 psi. Overhead cooler feature makes unit more compact. Intake and discharge openings are in horizontal plane on opposite sides of cylinder, to avoid air-flow reversal. —Fuller Company

276 **H-p air compressors** have output ranging up to 498-cu-ft air per min at 225 psi. Units incorporate crosshead design, letting crosshead shoes absorb large lateral stresses. These 2-stage water-cooled units have somewhat smaller cylinders than standard compressors. Air delivery is within a relatively low temperature range.—Atlas Copco

277 **Multistage centrifugal** air compressor is designed to furnish "100-lb air" for oxygen plants, centralized systems and other industrial applications. Unit has integral intercoolers between each stage of compression for high efficiency, says maker. A feature: side connections permit up or down piping, eliminate space-consuming axial inlets. Back-to-back impeller design is said to provide inherent thrust balance. Unit has only two journals and one thrust bearing—wearing surfaces cut to a minimum.—Clark Bros Company

● Application and controls

278 **Compressed-air dryers** have capacities of 10,000, 11,000 and 11,500 cfm at 100 psi. They'll dry any volume of compressed air—from total air for entire plant to minimal air for small operations. Adaptable to any air system, dryers are automatic, require no regeneration, heat or power. Process intercepts residual water vapor, microscopic abrasives and potent acid fumes which elude aftercooler, receiver and filters.—Van Products Co

279 **Leak detector** operates at 10 to 13 cu cm per sec. Ultrasensitive mass-spectrometer unit locates and measures size of leaks in vacuum, pressure or hermetically sealed systems, devices or components. All components are readily accessible—even cold trap may be cleaned without shutting down.—Crosby-Teletronics Corp

280 **Pneumatically actuated** control system was designed for gas-compressing applications. It incorporates safety functions to signal or shut down engines in case of malfunction of many measurable variables. System is explosionproof and has pneumatic circuitry with simplified components for maintenance ease. "Bull's-eye" annunciators flush-mounted on control panel do not have to be reset.—Robertshaw-Fulton Controls Co

281 **Regulator** handles gas temperatures to 450 F. Dome-loaded design uses gas rather than spring-loaded diaphragm. According to manufacturer this reduces pressure variation by causing less spring-rate effect. Unit adjusts from 200 to 2500 psig while maintaining accuracy of ±5% of dome load. Regulator body is made of corrosion-resistant steel, sealed with metal seals and isolated from aluminum-alloy dome by heat-dissipating finned section.—Western Sky Industries

282 **Rotary gas meter** measures industrial loads at pressures to 125 psig. Unit can be flange-mounted in either a horizontal or vertical gas line without additional

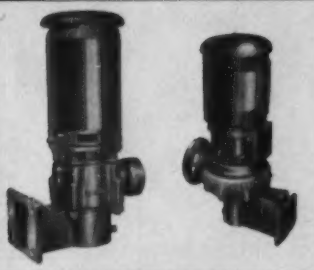
FOR EASY INSTALLATION, ECONOMY & TOP PERFORMANCE

Specify AURORA® PUMPS and CONDENSATE RETURN UNITS

Low NPSH—Smooth, quiet operation • high efficiency • less initial cost and lower operating expense • compactness

For many years Aurora Centrifugal Pumps and APCO Turbine Type Pumps, and Aurora Condensate Return Units have been serving a broad variety of heating and air conditioning applications with maximum dependability and operating efficiency. Applications include: condenser circulation, boiler feed, cooling towers, air conditioning systems, hot water circulation, and many special operations.

These Aurora Pumps and units are available in many different types and capacities for every type and size of operation. They are quality built for long, trouble-free operation. When maintenance is necessary, repairs can be made quickly and easily to get the pumps and system back in operation fast.

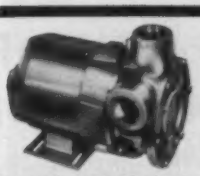


Type BJF and BCF
Flange Mounted

Especially applicable for OEM Equipment . . . Vertical mounting close-coupled design for maximum compactness . . . minimized space requirements . . . simplified, low suction mounting . . . optional discharge arrangements . . . low NPSH. Capacities to 1800 GPM and heads to 320 feet.

Type BP
Packaged CENTRI-PAC

22 packaged sizes . . . stainless steel seals for maximum corrosion resistance . . . stainless steel motor shaft . . . cast bronze impeller . . . self-venting with vertical discharge . . . low NPSH. Capacities to 450 GPM and heads to 140 feet.

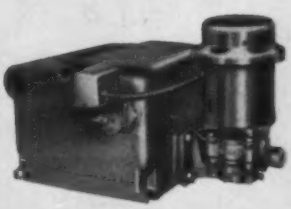


Model V-4
Close-Coupled Pumps

Maximum simplicity . . . single stage . . . mechanical seals . . . optional self-priming feature. Capacities to 30 GPM . . . Heads to 350 feet.

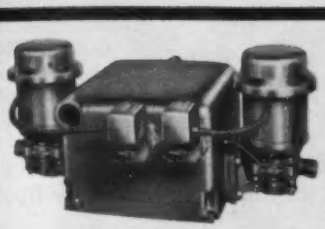
Type BCH
Close-Coupled End-Suction

With self-venting vertical discharge . . . interchangeable mechanical seal or packing inserts . . . low NPSH . . . unique suction spool arrangement. Capacities to 1800 GPM and heads to 320 feet—also available with flexible coupled drive.



Type CP
Cond-A-Pac Unit

Utmost compactness . . . cast iron receiver . . . mechanical seals . . . close-coupled . . . low return . . . complete unit ready for installation of lead lines. Capacities to 15,000 EDR—20 PSI. Also available as Type AR with APCO Turbine Type pumps—capacities to 10,000 EDR—pressures to 80 PSI.

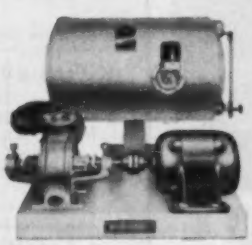


Type C
Heavy Duty Unit

For high capacity or heavy duty applications . . . broad flexibility . . . cast iron receiver . . . low return . . . mechanical seals standard . . . packing boxes on pumps optional when desired. Capacities to 150,000 EDR—pressures to 125 PSI.

Vertical Unit

For high capacities with special conditions . . . packing box only . . . ideal for applications where return is extremely low or below floor level . . . available as either simplex or duplex units. Capacities to 100,000 EDR—pressures to 60 PSI.



APCO
Horizontal Unit

Steel or cast iron receivers . . . turbine type pumps with vertical centerline discharge will not vapor lock . . . high efficiency . . . packing box standard . . . mechanical seals optional . . . available as either simplex or duplex units. Capacities to 100,000 EDR to 115 PSI.

WRITE FOR COMPLETE INFORMATION

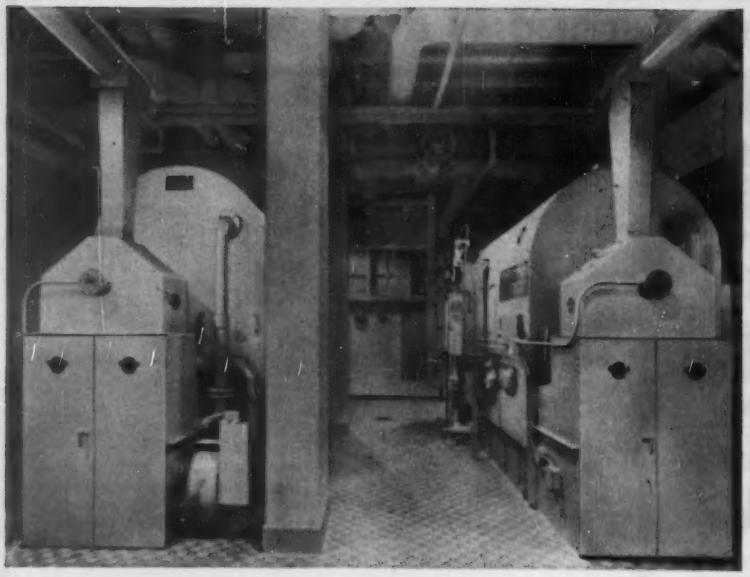
AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY

1000 LOUCKS STREET • AURORA, ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

For more facts circle 968 on Reader Service card, p 207



COAL ECONOMY + PACKAGE EFFICIENCY WITH THE COAL-PAK AUTOMATIC

All the advantages of a package water tube generator plus the economy of bituminous coal . . . that in brief is the significance of the Coal-Pak Automatic, developed in conjunction with Bituminous Coal Research, Inc. Fully automatic controls regulate coal feed, combustion and ash removal with cleanliness and efficiency which cannot be matched.

One of the many outstanding installations of Coal-Pak Automatics is in the new Coal Building, Washington, D. C., headquarters of National Coal Association. In addition to their heating role, the two 71-hp package units illustrated generate low-pressure steam which activates the absorption-type air conditioning system. Be sure to see this trend-setting Coal-Pak installation when you are in Washington, D. C.

Coal Building
1130 Seventeenth St. N. W.,
Washington 6, D. C.

For full information about the remarkable economy of International-BCR Coal-Pak Automatic units, write today for Bulletin 1100.

IBW BOILER BUILDERS SINCE 1866

THE INTERNATIONAL BOILER WORKS CO.

930 Spruce St. East Stroudsburg, Pa.

Steel Firebox Heating & Power Boilers
Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Generators • ASME Code Pressure Vessels & Welded Products.

support. It provides straight-through gas flow. Flow range to 3000 cfh combined with a working-pressure rating of 125 psig adapts this meter to many industrial loads. — Dresser Industries Inc, Roots-Connersville Blower Div

283 **Filter** removes up to 95% submicronic oil mist from compressed air. System involves four stages: (1) Impingement removes large droplets of oil by physicially impinging them on the baffle plate. (2) Coalescence welds extremely small particles of oil into larger groups. (3) In the absorption stage, a bed of clay is fluidized by air passing through it. Entire bed "boils" up and occupies total volume of the absorbing cylinder. (4) Filtration uses standard element to polish final air. Depending on application, any or all four stages may be used. A filter rated about 45 cfm operates 300 to 400 hr before it needs new charge of clay. Pressure drop is about five psi when new, tending to increase slightly with use. — Purolator Products, Inc

284 **Cleaner-oiler** services pneumatic tools without manual dismantling uses a solvent and lubricating oil carried in cylinder of unit. Normal plant air provides pressure to force solvent through cleaning tool. Weight is 30 lb.—The Marindus Company

• Gas-system design aids:

• Air compressors

747 **Compressors,** single- and 2-stage models ranging from ½ to 15 hp with pressures from 80 to 250 psi, are featured in 12-p bulletin SG-2. Westinghouse Air Brake Company, Le Roi Div

748 **Ac centrifugal compressors,** single-stage, are covered in 12-p bulletin 16B6048C. Describes pedestal-mounted, ball-bearing, bracket-mounted, pivot-shoe-bearing models in wide volume range. Allis-Chalmers Manufacturing Company

749 **Centrifugal compressors** with capacities from 800 to 8000 cfm, pressures to 1000 psi are featured in 4-p bulletin P-12. Carrier Corp, Elliott Co Div

continued

For more facts circle 969 on Reader Service card, p 207

circle 970 on Reader Service card, p 207 ➤

THE NEW, TIGHT-CLOSING PRESSURE REDUCING VALVE THAT *CAN'T FOUL*

If you like a simple, straight-forward solution to vexing valve problems, you're bound to be impressed with the new line of Leslie-Topper Pressure Reducing Valves. To avoid valve fouling, Leslie Engineers developed a tight-closing valve with an internal pilot that's completely out of the path of steam—*it just can't foul.* Let imaginative engineering simplify valve design and you get results.

Here's the one pressure reducing valve that handles poor steam conditions, intermittent or standby service better than any other valve. It provides high accuracy of regulation with negligible dead-end build up and costs only pennies for maintenance.

New, patented Leslie-Spiroflex* all metal diaphragm insures years of outstanding valve performance. It makes a long valve stroke possible in a packless design—there's nothing to leak, nothing to bind. It's time for a change when you can get rid of the cost and bother of fussy, old-fashioned pressure regulators.

*Trademark of Leslie Co.

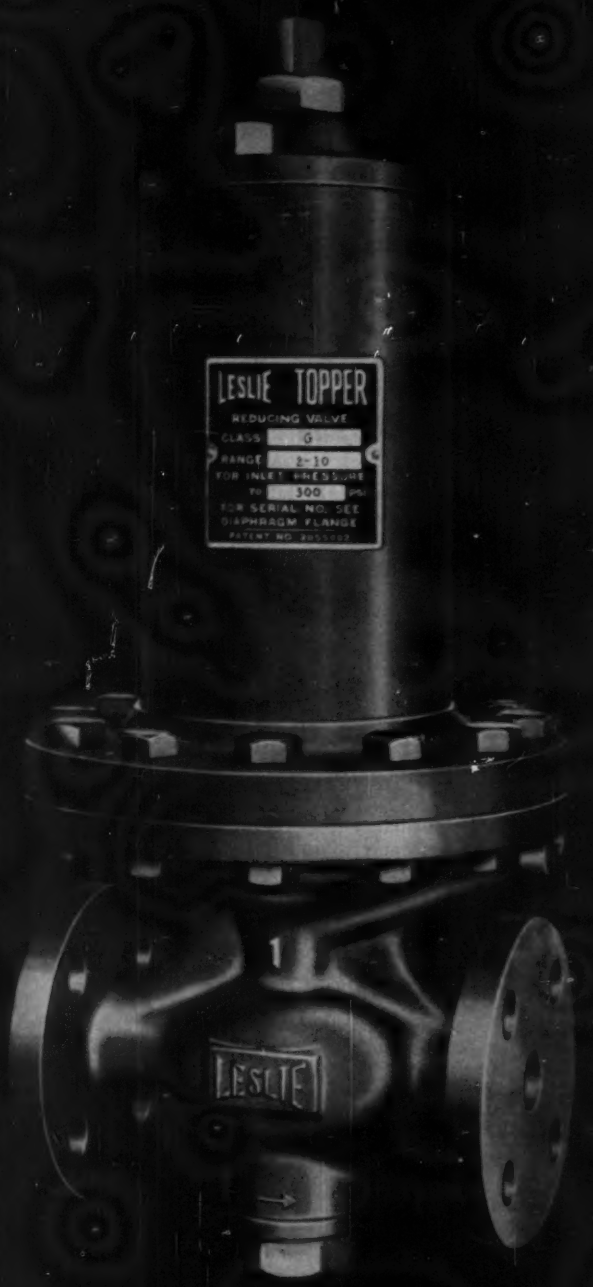
Leslie-Topper Selection Table

Size	Inlet Pressure PSI	Adjustable Pressure Range PSI	CLASS		
			Cast Iron Construction	Bronze Body Construction With Iron Superstructure Castings*	All Bronze Construction
½" TO 1¼"	UP TO 150	2 - 10	GKLL	GLL	GBLL
	OVER 125	2 - 10	GKL	GL	GBL
	UP TO MAXIMUM BODY RATING	5 - 20	GKM	GM	GBM
		15 - 35	GKH	GH	GBH
1½" TO 2"		2 - 10	GKL	GL	GBL
		5 - 20	GKM	GM	GBM
	UP TO 150	5 - 35	GKHL	GHL	GBHL

*All parts in contact with controlled fluid are of bronze.

For sizing and capacity data write for Bulletin 582 or contact your Leslie Engineer—he's listed in the Yellow Pages under 'Valves' or 'Regulators'.

Leslie Co., 701E Grant Ave., Lyndhurst, New Jersey



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Gas

Begins on page 314

750 **Packaged air compressor** selection guide for small models is a 16-p booklet. Covers air-compression process. Ingersoll-Rand Company

751 **Rotary stationary** compressors are specified in catalog of firm's line. Form E-269 has eight pp. Davey Compressor Company

752 **Packaged-pickup compressor** rated 300 hp and packaged units with hp ratings of 100 to 500 are featured in bulletins 91 and 92. Operating characteristics, construction details included. The Cooper-Bessemer Corp

753 **Turbocharged,** gas-engine-driven compressor is described and illustrated in bulletin 179. Specs and dimensions cover models from 660 to 1320 bhp. Clark Bros Company

754 **Portable rotary compressor** delivering 125 cfm of air at 100 psi at slowest—1600 rpm—is detailed in 4-p bulletin. Westinghouse Air Brake Company, Le Roi Div

755 **Stationary compressor** is topic of 24-p bulletin WN-114. Specs on three basic models of semiradially constructed units ranging from 1365 to 1948 cfm at 125 psi are included. Joy Mfg Company

756 **Stationary air-compressor** line is detailed in 4-p folder. Units deliver up to 19,400 cfm at 100 psi. **Atlas Copco**

757 **Air compressors** for standard 110-psi applications are topic of 16-p bulletin 135. Sizes range from 75 to 2000 bhp. Clark Bros Company

• Application

758 **Drying compressed air** for entire plant is described in 16-p moisture-control bulletin. Van Products Company

759 **Desiccant dryers,** heat-reactivated type, provide dry air or gas with dewpoint to -100 F. Bulletins A-309, AB-310 tell story. Trinity Equipment Corp

760 **Complete line** of firm's compressed-air products is presented in color-coded 24-p catalog 158—compiled for quick reference. Wilkerson Corporation

761 **Handling, storing** and converting liquefied oxygen, nitrogen and argon—principles and techniques—available in booklet from Air Reduction Sales Company

762 **Gas producers** prevent oxidation and decarburization during annealing, normalizing and hardening—covered in bulletin GED-3996. General Electric Company

continued

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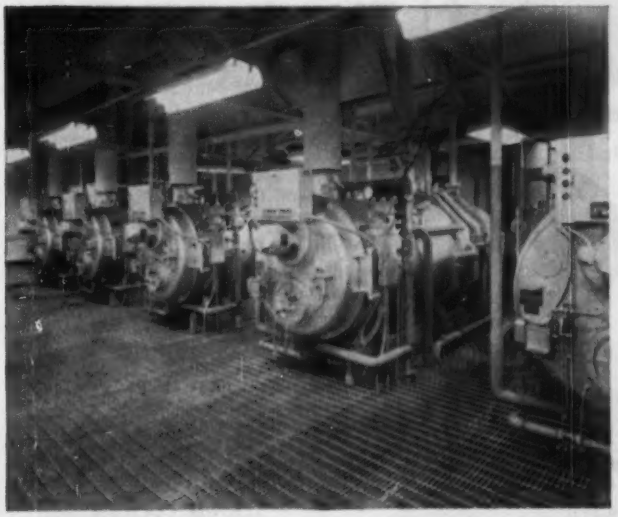
Diebold, Inc., Canton, Ohio, century-old manufacturer of bank protection and office equipment, replaced old, coal-fired boilers with new, fully automatic, gas-fired CB boilers and saved $15,000 to $18,000 in annual manpower cost. *All five of these new boilers are operated by just one man* — other personnel have been transferred to more productive work assignments. Bill Koby, assistant plant engineer, speaks highly of the ease of installation and the compact design.



New or old, there's one thing about any boiler that's up-to-date: you have to pay today's wages for the men who tend it. This becomes out-of-line overhead if you're operating a boiler designed in the days when man-hours were far less costly.

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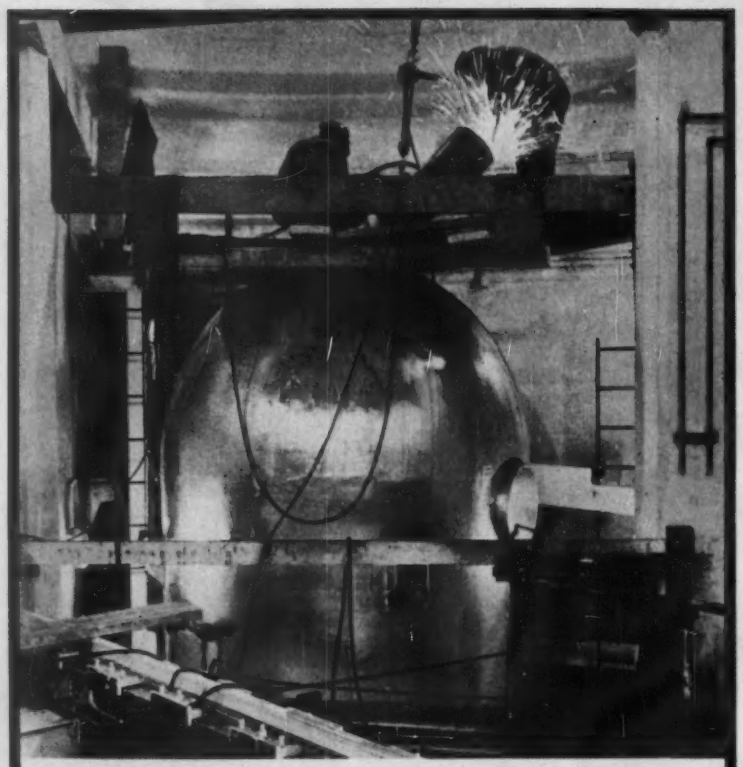
For more facts circle 972 on Reader Service card, p 207



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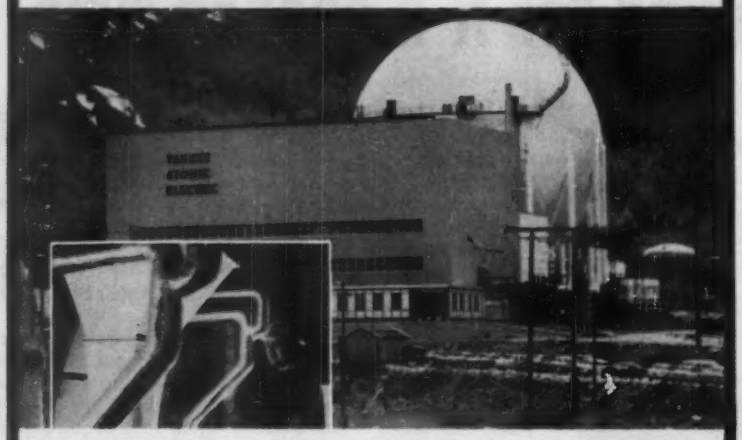

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Gas

Begins on page 314

763 **CO_2 and its value** to industry is explained in 24-p booklet. Covers history, applications, properties, manufacture, supply and distribution, regulating equipment and controls. Air Reduction Company, Inc, Pure Carbonic Company Div

764 **Air-hydraulic boosters,** pipe-thread fittings and piping case history—covered in new brochures. Flick-Reedy Corporation, Tru-Seal Div

765 **Aluminum-case meter** with capacity of 800 cu ft per hr at ½-in. differential, 0.64 specific-gravity gas, is topic of bulletin 314. American Meter Company

766 **Pneumatic-transmitting** rotameters are featured in bulletin 18N. Schutte & Koerting Co

767 **Air cylinders,** air-hydraulic boosters, air-oil circuits, high-speed cushions are covered in 24-p catalog P2647P. Mounting and dimensional data permit easy bore-size selection. Flick-Reedy Corporation

768 **Pneumatically - actuated** valves are covered in 8-p booklet HB-7. Construction details, operating characteristics, specs aid selection. Conoflow Corporation

• Controls

769 **Eliminating explosions** in compressor-starting air lines is topic of informative bulletin 172. Clark Bros Company

770 **Differential** temperature controller, expansion type for operation up to 2000 F, is described in new bulletin 152. Can be used for air-operated diaphragm valves, motors, dampers. Burling Instrument Company

771 **Gas-sampling systems** are described in handy 8-p brochure 59-B651. The Hays Corp

772 **Air-mixing units** with automatic volume-control features are covered in 14-p bulletin DD-6. Gives dimensions, performance data. Buensod-Stacey, Inc

773 **NEMA's 18-p "Standards** Publication" covers definitions, terminology and performance-measuring instruments for solid-adsorbent type dehumidifying and dehydrating equipment. Gas Drying, Inc

774 **Gas detectors,** portable, semi-portable and multichannel units are covered in 4-p folder 610-1. Houston Instrument Corporation

775 **Separator modules** for separating entrained liquids from corrosive gas streams are topic of 2-p catalog supplement S-6900. Union Carbide Corporation, National Carbon Company Div

For more facts circle 973 on Reader Service card, p 207

Hot reheat pipe of new 325,000 KW unit No. 5 at Pacific Gas and Electric Company's Pittsburg Power Plant in California, showing line-up of 3 Grinnell Constant Support Hangers.

Grinnell Hangers support piping at Pittsburg Power Plant

Grinnell manufactures a complete line of engineered pipe hangers and supports. Where reactive forces at terminal points must be kept within specified limits, Grinnell Constant Support Hangers are recommended. They are designed to provide an exact supporting force equal to the pipe load throughout the entire range of travel.

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Closeup of Grinnell Variable Spring Hanger supporting boiler feed pipe.

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For more facts circle 974 on Reader Service card, p 207

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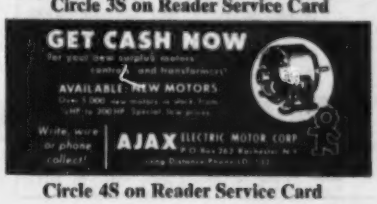

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800	Whse. (2)	Sq. Cage	2300	1800
750	G.E.	Slipring	2300	514
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
500	Al. Ch. 3 brg.	Slipring	440	514
500	Allis Ch.	Slipring	2300/440	600
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2300	3600
400	G.E.	Slipring	2200/4000	720
400	El. Machy.	Synch.	2300/1000	400
350	El. Machy.	Synch.	2300	900
350	Br. Boveri b.b.	Sq. Cage	4800/440	720
350	G.E.	Sq. Cage	2300	1800
400	G.E.	Slipring	2200/440	600
300	G.E.	Slipring	220/440	514
250	G.E.	Sq. Cage	2300/440	1200
250	G.E.	Sq. Cage	2300/440	450
250	Gen. Elec.	Sq. Cage	440	3600
250	Whse.	Sq. Cage	2300/440	600
250	Whse. (4)	Slipring	2300/440	600
200	Gen. Elec.	Synch.	550/440	400
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2300/440	720
200	G.E. b.b.	Sq. Cage	2300	900
150	G.E. TEFC (2)	Sq. Cage	220/440	900
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2300/440	600
200	A.C. TEFC	Sq. Cage	2300/440	1200
150	Whse.	Slipring	220/440	1200
100	G.E. TEFC-XP	Sq. Cage	220/440	1200
125	Whse. b.b.	Sq. Cage	220/440	900
125	A.C. TEFC	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. TEFC	Sq. Cage	2300	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
125	G.E. (2)	Slipring	220/440	514
100	Allis Ch.	Slipring	2300/440	600
100	Al. Ch. TEFC	Sq. Cage	2300	1800
100	G.E. b.b.	Sq. Cage	220/440	3600
75	G.E. b.b. (2)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec.	CY-221	250/350	1200
200	Gen. Elec.	BC	250	1450
100	Delco b.b.	Igte	120/240	1200
75	Allis Ch. b.b.	EB-146L	125	1500
60	Ideal	D	125	1150
60	G.E. b.b.	CD	600	1750
50	G.E. (2)	CD-1129	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	301-H	230	1150
200	G.E. (2)	MC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-310	230	320/1000
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
100	El. Dyn. b.b. (2)	30-S	230	450/1200
75/100	Whse.	SK-191	230	500/900
60	G.E. TEFC b.b.	CD-135	230	1150
50	G.E.	BF-16	230	250/1000
35/50	Rel. b.b. (2)	461-T	230	300/1200
40/50	Reliance b.b.	310-T	230	600/1800

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KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	G.E.	440 AC	250/350 DC
200	Allis Ch. (2)	440 AC	230 DC
200	Whse. synch.	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Whse.	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	120/240 DC
80	Star b.b. Synch.	220/440 AC	250 DC
75	Whse. Synch.	220/440 AC	250 DC
60	Ideal	220/440 AC	125 DC
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1—500 KW Condensing 200 PSI Turbine

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40/10 ton OET 47'3" Span 75' Lift AC
25 ton Powerhouse 36'6" Span AC
6 ton OET 43' Span 20' Lift DC

TRANSFORMERS

1—6000 KVA 3/60/44000—4160 Substa.
3—500 KVA 1/60/66000— 480
6—450 KVA 3/60/13800— 460
3—333 KVA 1/60/2300/4160 Y—480

HEAT & POWER CO. INC.

60 East 42nd St., New York 17, N.Y.
310 Thompson Bldg., Tulsa 3, Okla.

Circle 7S on Reader Service Card

BARGAINS!

1050 HP FAIRBANKS-MORSE DIESEL MODEL 32, 7 CYL., 257 RPM, 726 KW, FM 3/60/2400 WITH EXCITER, SWITCHBOARD, ETC. VERY LOW PRICE.

3000 CFM WORTHINGTON AIR COMPRESSOR 2 STAGE, HORIZONTAL, 164 RPM, 5 STAGE CONTROL. 650 HP 3/60/440 SYNCHRONOUS MOTOR. COMPLETE ACCESSORIES.

WHISLER EQUIPMENT CO.
1908 Railway Exchange Building
St. Louis 1, Mo.

Circle 8S on Reader Service Card

POWER EQUIPMENT

15000 KW, NEW, Cond. Turbo-Generator 3/60, 13800 V., 3600 RPM. 850 PSIG, 900°TT with boiler.
5500 KW, G.E., Non C. Turbo-Gen. 3/50, 2300 V, 3000 RPM 600 PSIG 650°TT, 150 PSIG Exh.
1500 KW, G.E. Cond. Extr. Turbo-Gen. 3/60, 2400 V., 3600 RPM, 200/400 PSIG, 750°TT, 3# A.E.
1000 KW, Worth.-Moore, Cond. Extr. Turbine, 3/60, 245/490V, 3600 RPM 130-300 PSIG, 10# Extr.
300 KW, G.M. 8-268A, Diesel Units (2) 3 ph. 60 cycle, 480 V, 1200 RPM
500 KW, .8 P.F. West. 3/60, 240/480 V 300 RPM, Gen. direct conn. to Ames Vertical Uniflow Engine.

BREW, WOLTMAN & COMPANY, INC.
50 CHURCH ST., N.Y. 7, N.Y.

Circle 9S on Reader Service Card

NEW EQUIPMENT FROM THE UNCOMPLETED BATTLESHIP U. S. S. KENTUCKY

Installed but never used
Built of finest materials

WESTINGHOUSE 1250 K.W. TURBO-GENERATORS

(4)—Westinghouse—440/3/60—850°—540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. Capacity: 210,000 lb. steam/hr. Ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters. Can be converted for #2 oil and natural gas. Fully automatic.

LARGE DEAERATING FEED HEATERS

Monel construction—spray type—capacity 480,000 lbs./hr.—vent condenser—single pass—heating surface 174 sq. ft.—all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

Will sell separately for testing, wind tunnel or similar work. (2) high pressure—24,400 HP—12 impuse stages—4909 RPM—working pressure 540 lbs.—825°F. (2) low pressure—28,600 HP — 3913 RPM — working pressure 49 lbs. steam—424°F—2-6 stages of impulse.

FEED PUMPS

Ingersoll-Rand—5"—three stage—500 GPM at 750 lb. discharge. BHP 330—5000 RPM—Worthington turbine—573 lbs.—non-condensing—back pressure 20 lbs.

FORCED DRAFT BLOWERS

29,000 CFM—max. static 35"—normal 21"

LUBE OIL COOLERS

1600 square feet

MANY OTHER ITEMS FOR SALE. SEND US A LIST OF YOUR REQUIREMENTS

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 10S on Reader Service Card

ELECTRICAL EQUIPMENT

TURBO GENERATORS

4—600 KW G.E. 3/60/440V/1200 G.E. Cond—575
4—400 KW G.E. 3/60/440V/1200 G.E. Cond—525
4—400 KW G.E. 120/240V DC/1200—Moore Cond.
2—300 KW West. 120/240V DC/900 West. Non/Cond.
8—250 KW West. 120/240V DC/1200 West. Non/Cond.

DIESEL GENERATORS

4—250 KW West. 3/60/450/1200 with G.M. 8-268A
4—250 KW West. 3/60/450/900 with Cooper-Bessemer
2— 80 KW Delco 3/60/450/1200 with G.M. 6-71
4—100 KW Allis Chalmers 120/240/1200 with G.M. 3-268A

DRY TYPE TRANSFORMERS

1 ph — 450 pri. — 117 sec.
(15)10KVA — (25)15KVA — (5)20KVA — (30) 25KVA—(10)37½KVA—(5)50KVA—(6)75KVA

3000 PSI AIR COMPRESSORS

20 c.f. per hr. Worthington with 50 HP, 3/60/440/3300 RPM
30 c.f. per hr. Hardie Tynes with 75 HP, 230 volt, 2000 RPM

Write or Phone for Details & Locations:

D. R. GLAZER COMPANY
45 Nassau Street, New York 5, N. Y.
BE 3-5033
Sales Agent for Hugo Neu Corp. & Lipsett, Inc.

Circle 11S on Reader Service Card

EXCEPTIONAL BARGAIN OFFERING

COMPLETE POWER GENERATING STATION

ALL OR PART · EXCELLENT CONDITION · IMMEDIATE DELIVERY

TURBO GENERATORS

1—30,000 KW, 3/60/13,200 V, 1800 RPM, General Electric condensing, 275 PSI, complete with shaft exciter, switchgear, Worthington surface condenser and auxiliaries.

2—15,000 KW, 3/60/3,300 V, 1800 RPM, General Electric condensing, 275 PSI, complete with shaft exciters switchgear Worthington surface condensers and auxiliaries.

1—1000 KW, 3/60/240 V, 3600 RPM, General Electric single-stage non-condensing, 200 to 235 PSI, 15 to 25# back pressure.

1—500 KW, 3/60/440 V, 3600 RPM, General Electric non-condensing, 200 PSI, 10# gauge back pressure.

1—400 KW, 3/60/440 V, 3600 RPM, Allis Chalmers non-condensing, 323 PSI, 600°TT, 110# back pressure.

1—300 KW, 125/250 V, 1200 amperes Westinghouse direct current non-condensing geared turbine generator unit, 200 to 250 PSI, 10 to 25# back pressure.

BOILERS

5—2000 HP B&W cross drum 300 PSI complete with superheaters, economizers, soot blowers, stokers.

2—1345 HP B&W wrought steel longitudinal drum 300 PSI complete with superheaters, soot blowers, stokers.

8—444 HP B&W cross drum wrought steel 250 PSI complete with superheaters, economizers, soot blowers, stokers.

POWER TRANSFORMERS

3—1500 KVA General Electric water cooled, 3/60/14,520 V primary, 600 V secondary.

3—500 KVA General Electric single phase, 60 cycle, oil cooled, 2400/4160 V primary, 240/480 V secondary.

OVERHEAD AND GANTRY CRANES

1—75 Ton capacity Whiting Mfg. Co. bridge crane, 51 ft. span, complete with auxiliary hoist, operating motors, control and rail.

1—10 Ton capacity Whiting Mfg. Co. Gantry crane, 140 ft. span, stationary bridge, complete with trolley and operating motors, control equipment and rail.

WATER WORKS PUMPS — MODERN, EQUIVALENT TO NEW

1—15,000 GPM Allis Chalmers Type LS centrifugal pump, 24" suction diameter, 18" discharge diameter, discharge head 117 ft., suction head 5 ft. total discharge head 112 ft., shutoff head 139 ft., direct connected to a 500 HP, 880 RPM, 3/60/2300 V Allis Chalmers drip-proof wound rotor motor Type ANYW equipped with operating valves and switchgear.

1—15,000 GPM Allis Chalmers Type SF, 1100 RPM, centrifugal pump, 18" suction diameter, 18" discharge diameter discharge head 285 ft., positive suction 70 ft., total discharge 216 ft. at shutoff head 270 ft., coupled to a 1000 HP, 1190 RPM, 3/60/2300 V Allis Chalmers squirrel cage induction motor Type ANW complete with operating valves and switchgear.

CARS—STANDARD GAUGE

1—50 ton steel hopper bottom (drop-bottom gondola car).

2—30 cu. yd. automatic air dump, all steel twin vertical cylinders, automatic compression lock with extended sides to increase capacity to 45 cu. yds. (wood bottom covered with steel). Western Wheel Shapor Co. mfr.

2—Clark Type C-8 all steel extension side cars.

1—40 ton steel gondola car, flat bottom type.

BLOWER FANS

4—85,000 CFM Turbo-Conoidal Size 7 Buffalo Forge Co. fans each direct connected to a 100 HP, 3/60/550 V, 900 RPM G.E. motor.

2—6500# pressure Multi-vane Size 11 fan, B.F. Sturtevant Co., each direct connected to a 200 HP, 3/60/550 V, 514 RPM G.E. motor.

6—43,000 CFM forced draft fans Turbo-Vane, B. F. Sturtevant Co., each direct connected to a 75 HP, 3/60/550 V, 1200 RPM G.E. motor.

6—60,500 CFM induced draft fans Multi-Vane, B. F. Sturtevant Co., each direct connected to a 100 HP, 3/60/550 V, 1200 RPM motor.

COAL AND ASH HANDLING EQUIPMENT

1—Coal larry, automatic electric traveling hopper car, complete with motors, control and rails, 4-wheel 80 cu. ft.

1—Drag line scraper system, R.H. Beaumont Co. mfgr., complete machinery—house with clutch and friction brake operated by Pilot wheel, gear connected to motors.

1—Skip hoist system, R. H. Beaumont Co. mfgr., complete with track hopper, loaders, buckets, with 7½ ton coal larry.

CENTRIFUGAL CIRCULATING PUMPS

1—25,000 GPM horizontal split-case Worthington pump, Size 30-CL-BS, direct connected to a 900 HP, 3/60/440 V, 450 RPM G.E. motor.

1—32,000 GPM horizontal split case Worthington centrifugal pump, Size 40-CL-BS, direct connected to a 400 HP, 3/60/550 V, G.E. motor.

1—500 GPM Worthington pump, 205 ft. pressure, Size 4-CL-BD Volute direct connected to a 60 HP, 3/60/550 V, 750 RPM, G.E. motor.

2—NEW, UNUSED Babcock & Wilcox Company coal pulverizers, Type E-56, Class III-BA, for direct firing, assembled complete with integral type pulverizer feeders, lubrication system and internal elements, each having capacity of 14,500# per hour of 12,500 BTU coal, equipped with:

2—15,000 CFM American Blower Corporation primary air fans, Type "PB", 40" diameter, single width, single inlet and structural supports with:

2—NEW, UNUSED 150 HP Westinghouse Type CS induction motors, 3 phase 60 cycle, 2300 volts, 1800 RPM.

UTILITIES MACHINERY CORPORATION

1965 EAST SIXTH STREET **Tel: CH. 1-0210** **CLEVELAND 14, OHIO**

Circle 125 Reader Service Card

UNUSED—ASSEMBLED—NEW

IN ORIGINAL MANUFACTURER'S PACKING CRATES

BOILERS (Package type)

B&W—80,000 lbs./hr.—475 psig., 740°TTF, oil fired (shipped intact as one integral unit)
B&W—122,500 lbs./hr.—635 psig., 850°TTF, oil fired (unassembled)
B&W—153,600 lbs./hr.—634 psig., 850°TTF, oil fired (unassembled)

TURBOGENERATORS

4600 KW GE Turbine—Gen Set. Cond 410psi, 725°TTF, 28.5 Hg exh. 3/83.3/2700V PF 1.0—New
1800 KW GE Turbine—Gen Set. Cond 410psi, 725°TTF, 28.5 Hg exh. 3/60/1735 V PF 0.9—New
1500 KW Westinghouse—Gen Set. Non Cond 400psi, 3/60/480V PF 0.8
1000 KW Westinghouse Turbine Gen. Set. Non. Cond. 190psi, 600°TTF, 3/60/480V/3600RPM PF 0.8

STEAM TURBINES

1000 SHP GE Cruising Cross Compound, 525psi, 825°TTF, 81psi exh, 10,119/350 RPM with Falk reduction gears—New
3000 SHP GE HP Main propulsion turbine 410psi, 9040RPM, 725°TTF
3000 SHP GE—LP Main propulsion turbine 40psi, 9040RPM } 1 Set—New
11,550 SHP GE HP 12 Stage Cross compound turbine 525 psig, 825°TTF 5870RPM
13,450 SHP GE LP 48psig, 4714RPM with Westgh speed decreaser gear assy. } 1 Set—New
294 HP Worthington-Moore, Non-Cond. Form ZS2R, 310psig, 650°TTF, 2psi-exh, 3560RPM
250 HP Sturtevant non-condensing Turbine—575psi, New

PUMPS, CENTRIFUGAL (Motor driven)

283 GPM @ 375'TDH, Ingersoll Rand—2GT, w/60HP 3525RPM 3/60/220/440V (Used)
275 GPM @ 635'TDH, Ingersoll Rand—2GT, w/75HP 3525RPM 2/60/2300V (Used)
200 GPM @ 1300'TDH, Ingersoll Rand—1½CNTA, w/Base, Motor optional

PUMPS, CENTRIFUGAL (Turbine driven)

460 GPM @ 750psi discharge, Worthington, w/350HP turbine, 575psi, 4900RPM—New

BLOWERS, TURBO-CENTRIFUGAL

20,000 CFM @ 17"WC, Westinghouse, Vaneaxial, w/Turbine, 82.5HP, 375psi, 10psi—exh, 4625RPM—New
24,000 CFM @ 26"WC, Sturtevant Co, Rexvane, w/Turbine, 191HP, 400 psi, 10psi—exh, 3525RPM—New
31,250/24,000 CFM @ 45"/28" W.C. Sturtevant Propeller-Fan w/182HP, 375psi, 15psi exh, 5650/4600RPM

WABASH POWER EQUIPMENT CO.

9750 SKOKIE BLVD., CHICAGO, ILLINOIS—TEL. OR 3-8118

3757 Wilshire Blvd. Los Angeles 5, Cal. | 1684 Hudson San Francisco, Cal. | 730 Dearborn Seattle, Washington

Circle 13S on Reader Service Card

TRANSFORMERS

BOUGHT · SOLD · RENTED

REWOUND · RE-DESIGNED

MANUFACTURED

Ask for our Stock List

For Sale

3—2500 KVA G-E 6900—2300Y
3—2500 KVA G-E 6900—2400/4160Y
3—2500 KVA G-E 6900—7200/12470Y
4—2500 KVA W-H 34500—2400/4800/11000
3—1500 KVA G-E 69000—2300Y
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y

THE ELECTRIC SERVICE CO., 5322 Hetzel St., Cincinnati 27, Ohio

"America's Exclusive Independent Transformer Service Shop"

Circle 14S on Reader Service Card

FOR SALE

1—750 KW General Electric Turbine Generator—10,500# of steam per hour—225# pressure, 490°F temp.

1—1250 KW General Electric Turbine Generator—17,500# of steam per hour.

80% power factor, 3 phase, 60 cycle, 480 volts, 3600 RPM, 3-stage non-condensing 5# extraction steam turbine generator unit, complete with direct connected shaft exciter and switchgear.

Price upon request. Available for inspection. Sold as is, FOB cars, Rockford, Illinois

NATIONAL LOCK COMPANY

Purchasing Dept., 1902 7th Street, Rockford, Illinois

Circle 15S on Reader Service Card

AUTOMATIC and MANUAL
Gas or DIESEL GENERATOR UNITS
Complete Switchboard Design and Construction
USED & REBUILT EQUIPMENT
UNIVERSAL POWER ENGINEERING CO.
382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

Circle 16S on Reader Service Card

MOTORS · GENERATORS
TRANSFORMERS
NEW · REBUILT
ELECTRIC EQUIPMENT CO.
WORLD'S LARGEST INVENTORY
CALL COLLECT GL 3-6783
P.O. BOX 51 · ROCHESTER 1, N.Y.

Circle 17S on Reader Service Card

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/3400
3	750	G.E.	K	1	4600-120/240
1	300	Penns.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/3820Y-120/240
3	200	Al.-Ch.	C88	1	2400/4160-240/480
3	200	Amer.	CU	1	4160/7200-240/480
3	75	G.E.	KP	1	2400/4160-120/240
1	50	Amer.	Abestal	3	4160-120/208Y
3	50	Niagara	Dry	1	2400/4160Y-120/240
3	50	Harrison	Dry	1	2400/4160Y-220/440
2	3000	G.E.	OA-T	3	26,400-4160/2400
6	25	G.E.	Dry	1	2300-440

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 220V.
1	75	G.E.	1200	125	2300/4160 Syn.
1	175	West.	1200	125	4150 Syn.
1	200	G.E.	1200	250	2300/4160Y BR
1	300	Al.-Ch	1200 125/250		Syn. 440V.
1	1000	West.	720	600	2300/4160Y Syn.

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Weathe 3/60/480 —1200

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	900	CW	220/440
1	60	G.E.	1800	MT	220
1	60	G.E.	900	MT340	440
1	75	G.E.	600	IM	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	450	West.	1800	CW-4-20-9	220
1	500	G.E.	450	MT	2300
1	800	G.E.	1200	M389Z	2300/4160Y
1	50	G.E.	570	MT552	220/440

D. C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	350	G.E.	1200	Pedestal
1	30	G.E.	1750	173 FR
1	30	West.	600/1400	SK-4G1343

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis. Chalmers, 2300/4160Y
1—275 HP, 1120 RPM G.E. Type KT 5509R8 2300V
2—200 HP, 1790 RPM, G.E. Elec. K.P. TEFC, 2300V
3—150 HP, 1800 G.E. TEFC Exp. 220/440
1—100 HP, 1775 RPM G.E. KTP-543 3 ph 60-440V.
1— 75 HP, 3600 RPM Cont. NP 505—440V Exp. P
1— 50 HP, 3600 Cont. Ex. Pr. 220/440
2—100 HP, 3600 RPM Cont. NP 583-S 440V X.P.
1—100 HP, 1200 RPM West-CSP 220/440
1—200 HP, 450 RPM GE TS 7654-2300

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Pum BL 2300V.
125 HP 600 RPM G.E. Type TS 2300 V.
125 HP 900 RPM Elect. Mach. 4900 V.
150 HP 3600 RPM G.E. type TS Fr. 256T 2300 V.
150 HP 1800 RPM G.E. Type TS 220 V.
300 HP 720 RPM Elec. Machinery L.c.f.c. 2300 V.
325 HP 900 RPM West—2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.
75 HP 1200 RPM Crocker-Wheeler Type ALT 220/440 V. B.B.

FOR POWER
J.L. HEMPHILL & CO.

Circle 18S on Reader Service Card

FOR SALE

1050 KVA DIESEL UNIT

1050 KVA Nordberg supercharged diesel engine generator unit, 3 phase, 60 cycle, 2400 volts, 327 RPM.

New 1947 — Excellent condition.

The above unit is still installed and complete with all auxiliaries as in operation.

INTERNATIONAL POWER MACHINERY COMPANY
1612 Union Commerce Bldg.—MAin 1-9514
Cleveland 14, Ohio

Circle 19S on Reader Service Card

FOR SALE

3—300 H.P. Erie City Economic Boilers 150 PSI. Complete steam plant in operation until Sept. 30. Available with underfeed stokers or gas-oil combination burners. Very good condition. Built 1950.

James H. Moore & Company
P. O. Box 963
Oak Ridge, Tennessee
Phone 59389

Circle 20S on Reader Service Card

COMPLETE MODERN 400 LB. POWER PLANT

3750 KVA Westinghouse Turbine Generator — 2 600 HP Combustion Engineering Boilers, 450 PSIG W. P. Turbine is 400 PSIG 750° FTT with surface condenser and auxiliaries. Generator 3/60 6900/4160 with Exciter and Switchboard. Surface Condenser and all auxiliaries.

This plant is complete in all respects and can be inspected as originally installed. Photographs, prints and specifications available

Other turbine Generators

1-2000 KW GE	600# 750° Non-Cond. 150# BP 4160V/6600V
2-3000 KW Westinghouse	600# 750° Non-Cond. 125/150# BP 2400V
1-2500 KW Allis Chalmers	400# Autext 150° Non-Cond. 30# 480V
1-2500 KW Westinghouse	125# Non-Cond. 10# BP 2300V
1-2500 KW GE	400# 750° Autext 25# Condensing 600V
1-5000 KW Westinghouse	850# 850° Non-Cond. 110# BP. 2400V
1-6000 KW G.E.	200# Condensing 2300V
1-7500 KW Allis-Chalmers	850# 850° Non-Cond. 110# BP.

Cable Address: CHASWEAVER

CHARLES WEAVER, INC.

19701 JAMES COUZENS HIGHWAY
DETROIT 35, MICHIGAN

Telephone: BRoadway 3-1900

Circle 21S on Reader Service Card

FOR SALE

1500 KW, 80% Power Factor, 3 phase, 60 cycle, 2300 volts, 3600 RPM, General Electric 5-stage noncondensing steam turbine generator unit, 375 PSIG, 700° FTT, 125# exhaust back pressure, complete with direct connected shaft exciter and switchgear. Excellent condition—available immediate delivery.

EUCLID ENGINEERING CORPORATION
909 National City East Sixth Building
Cleveland 14, Ohio

Circle 22S on Reader Service Card

AIR COMPRESSOR

6700 CFM Sullivan 2 stage Model HE 522 30½" & 18½" x 20" direct connected to 1250 H.P., G.E. Syn. Motor—200 RPM. 3/60/4160v.

B. M. WEISS CO.
Girard Trust Bldg. Philadelphia 2, Pa.

Circle 23S on Reader Service Card

FOR SALE
ATLAS IMPERIAL DIESEL

Model #6HS3358, Engine #12692 600 H.P. 300 RPM 6 cylinder, 15" Bore x 19" Stroke; 4 Cycle including New Maxim exhaust silencer, air starting equipment, oil filter & receivers. Heat exchanger with pumps. Recently overhauled. Now set up & we will be pleased to run for inspection. Can be seen anytime by appointment.

MERRIMAC HAT COMPANY, INC.
18 Cedar Street, Amesbury, Mass.
Tel. Amesbury, Mass. 1180

Circle 24S on Reader Service Card

HIGH PRESSURE VALVES
— USED —
EXCELLENT CONDITION

11 Crane motor operated gate valves 12", Limited Torque, Catalog 83½-U, Disc and Seat HF, Pressure 1000 lbs., Temperature 900°, Weld-On Type, Body WC 15, Stem CR-13.

3 Edwards hand operated globe valves 12", Figure 3505-Y, Disc and Seat HF, Pressure 1500 lbs., Temperature 950°, Weld-On Type, Body #1703, Stem CR-13.

Approx. 150 Crane, Edwards, and Hancock Carbon Moly Welding Valves, ½" to 6", 1200 to 1500# Pressure, 900° F.

T. B. Rees
Kennecott Copper Corp.
Kearns Bldg., Salt Lake City, Utah

Circle 25S on Reader Service Card

1—Gardner-Denver air compressor, 445 cfm @ 100# pressure, 6 cylinder, 2-stage, 1952. Req. 100 HP.

2—E. Keeler 200 HP water-tube boilers, 100 psi, Stoker fired, 1945.

1—Babcock & Wilcox #32E coal pulverizer, air swept, 75 HP.

1—24" x 538' long trough belt conveyor.

PERRY EQUIPMENT CORP.
1422 N. 6th St., Philadelphia 22, Pa.
Phone: POplar 3-3505

Circle 26S on Reader Service Card

SPECIAL OFFERING!

3 NEW UNUSED 850 KW DIESEL GENERATOR SETS

installed but never run

ENGINE:

Fairbanks-Morse model 38D8 ⅛ — bore & stroke 8⅛ x 10—@ 720 RPM.

GENERATOR:

Complete—drip-proof enclosure—850 KW 440/3/60 @ 720 RPM—80% P.F.—with direct-connected 7½ KW exciter and switchgear.

The above units are complete with filters, strainers, heat exchangers, mufflers, air intake silencers, etc., and are complete in every detail. They are mounted on a common pre-fab sub-base, and have the latest deadfront switchgear, distribution & voltage regulators. These units are perfect in every respect & have been carefully preserved by the U.S.N. Can be seen in our warehouse or aboard the "Hawaii."

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 27S on Reader Service Card

AUTOMATIC VOLTAGE REGULATORS

Complete stock of Allis Chalmers, General Electric and Westinghouse, new — unused. Save $$$

ELECTRIC POWER EQUIPMENT COMPANY
15 SO. ELM ST. DENVER 22, COLO.

Circle 28S on Reader Service Card

37 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	4000/2300	G.E.	1200
400	2200/440	G.E.	600
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
400	2200/440	G.E.	ATI	720
300	2200/440	G.E.	TS	1200
200	440	G.E.	TS	600
150	440/220	Whse.	G	1200
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2288/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SKDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/4000	Cont'l.	Sol.-Prf.	720
300	2300/400	G.E.	RT	600
250	2300/4000	G.E.	K	720
200	2200	G.E.	RT	1200
200	2200	Cont.	TEFC	3200
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2300/440	G.E.	TEFC	3600
125	2200/440	G.E	FT	1200
100	440	Whse.	X-pf.	3600
100(2)	440	Cont.	X-pf.	1800
100(3)	4000/2300	L. Allis	OX	1200
100	2300	Cont'l.	OX	1200
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1600 Amp., DA-50, Whse., 600 V., Air
1—600 Amp., G.E., 15 KV, Rel. oper.
8—600 Amp., G.E., 15 KV, manual
1—600 Amp., Whse., 7.5 KV, outdoor, New.

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	900
90	230	G.E.	CD	1750
50	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input.. AC	Motor Type	Output V.. DC
300	Whse.	4150/400	Syn.	250/125
150	G.E.	440/220	Syn.	250
125	G.E.	440/220	Sq. Cs.	125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh	440/220	Sq. Cs.	240/120
65	G. E. B	2300/440	Sq. Cs.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al Ch. 2400/4160Y—600 volts, 3 ph.
3—500 kva, G.E., 12800—240/480 V.
3—300 kva, Mol., 13,800—230 V.
3—333 kva, G.E., 13,800—2400 V.
3—333 kva, G.E., 2400—240/120 V.
2—333 kva, Mol., 2400—240/480Y.
2—200 kva, G.E., 2400—480Y, Pyr.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E. 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
2—150 kva, G.E., 12 200—2300 V.
3—100 kva, Whse., 2400—240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

3—37½ kva, 1800 R. 220 V 3/60, Cont'L, 6 cyl.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

Circle 29S on Reader Service Card

NEW EQUIPMENT

from the unfinished Battle Cruiser "Hawaii"

Material installed but unused, and all in prime condition

8 B&W BOILERS

150,000 lbs/hr—634 lbs. WP—850°TT—6053 sq. ft. generating surface. (Can be converted to natural gas or #2 oil) 11' wide—21' high—15' deep.

4 LARGE DEAERATING FEED HEATERS

833 820 lbs/hr—manufactured by Worthington—test pressure 45 pounds.

8 MAIN CONDENSATE PUMPS

4 motor driven—4 turbine driven—400 GPM @ 56 lbs—11.5" submergence—1170 RPM—BHP 27.3 (Motor driven: GE 30 HP motor 440/3/60—1170 RPM. Turbine driven: Sturdevant turbine—500 lbs —20 lbs S.P.—27.3 BHP @ 5400 RPM—gear 1170 RPM—1299 lbs. steam/hr.)

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 33S on Reader Service Card

ELECTRICAL POWER EQUIPMENT

SLIP RING MOTORS

3 ph 60 cy 220 or 440 volts

HP	RPM	MAKE	TYPE
1500	3 4*	Al.-Ch.	Mill Type
1200	360*	Al.-Ch.	Mill Type
900	160*	Al.-Ch.	Mill Type
600	1800*	Gen. Elec.	M-6315S, Dppf. New
500	1200	Gen. Elec.	M-6345Z, Dnof.
400	720	Gen. Elec.	MT-573Y
350	900*	West.	CW
350	1800*	Al.-Ch.	ARYW (2)

*2200 volts or higher

SQUIRREL CAGE MOTORS

3 ph. 60 cy. 220 or 440 volts
(*2200 volts or higher)

HP	RPM	MAKE	TYPE
1250	3600*	Al.-Ch.	ANX
800	1800	West.	CS84C
600	600*	West.	CS-44-C15 Dppf (2)
500	1200	G.E.	I-K
400	1800*	L. Allis	BB, Sppf.
400	1800	West.	BB, Dppf.
400	1200	G.E.	KTP-565
350	3600	Cr.-Wh.	SC, Dppf.
300	1200	G.E.	KT-559, Dppf.
300	600*	West.	CS-39A
300	600*	West.	CS-1902

MOTOR GENERATOR SETS

KW	Make	Motor A.C.V.	Generator D.C.V.
1000	West.	4160	250
600	G.E. (3 unit)	2300/440syn.	125/250
500	West.	2300/440syn.	125/250
400	Al.-Ch.	2300/440syn.	125/250
300	West.	2300/480syn.	250
200	Rel.	2300/440syn. TS	500
200	G.E.	2300/440syn. TS	250/275
200	Rdgwy	2300syn.	250
150	Al.-Ch.	220/440/220	250
150	West.	2300/440/220syn.	125/250
125	West.	2300/480syn.	250
125	G.E.	2300/480syn.	250
100	West.	2300/4000syn.	250/275

TRANSFORMERS

Special Offer — Like New

5—1250 KVA Allis Chalmers Class OA Oil filled 3ϕ ph 60 cy 34,000 Volt primary, 480 volt secondary with taps, manufactured 1955.

Write for current complete stock lists on electrical power equipment you need or send your list of surplus and used equipment for our offer.

Phone CAnal 6-2900

CHICAGO Electric Co.

1320 W. CERMAK ROAD • CHICAGO 8, ILL.

Circle 30S on Reader Service Card

BOILERS NEW UNASSEMBLED

# Steam/hr.	Key	PSI	Temp
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.
315 Orishany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

Circle 31S on Reader Service Card

DIESEL ENGINES

2—1700 HP at 180 RPM, Nordberg type TSM, 6 cylinder 21½" x 29" (also Hamilton R-621-SA w/same characteristics)
these engines are rated 2400 HP at 225 RPM when driving generators.

6—1600 HP General Motors 16-278A

2—1800 HP Fairb. Morse 38D8, ⅛ OP

HUGO NEU CORPORATION
45 Nassau Street, New York 5, N. Y.

Circle 32S on Reader Service Card

TRANSFORMERS

1—	10667 kva	G.E.	3/60/33000/11500
1—	6667 kva	Westinghouse	3/60/115,000Y/13750
1—	6000 kva	G.E.	3/60000/2400/
1—	2000 kva	Nla. Ackarel.	3/13800/4160Y/2400 new
1—	5000/6250 kva.	GE 60-1, type OA, FA.	110000Y pri. 11500 V sec.
1—	3000/3900 kva	GE 60/3.115000 V pri 34500 V sec. ser #001061	unused
3—	1500 kva	Wagner. 1/60 cy. 6900—2400/4160Y	
3—	1000 kva	Standard. 1/44000/6900	
3—	1000 kva	Standard. 1/69000/4160Y/2400	
3—	1000 kva	Standard. 1/34400/480	
3—	833	Allis Chalmers 1/60/12,000-480	
3—	750 kva.	GE 1/60/13,800 pri. 480 sec.	
3—	500 kva.	GE 1/60/11,500 pri. 480 sec.	
4—	500 kva.	oil filled Standard. 1 ph. 60 cy. 2400/4160Y pri 480 Sec.	
3—	500 kva	Westinghouse 1/60/13800 pri 480 sec.	
3—	333 kva	G.E. 19200/480	
3—	333 kva	G.E. Type H, form K-60-1-13800 Pri 600/2400 sec. Oil filled	
1—	300 kva.	ELECTRIC SERVICE CO., Trans. 1/60 cy. 240, 50, 90, 120, 150, 180 210. HA BB	
1—	300 kva	Penna. 3/60/2400/4800 pri. 120/208Y Sec.	
3—	200 kva	dry Kuhlman. 1 ph. 60 cy. 2400 pri. 480 sec.	
3—	150 kva.	Uptegraff 1/60/4800 pri. 480 sec.	
3—	250 kva.	dry Standard. 1/60/2400/4160Y pri. 240/480 sec.	
3—	150 kva	G.E. 1/60/2400/4160Y pri. 240/480 Sec.	
3—	100 kva.	Uptegraff 1/60/2400/4160Y pri. 240/480 sec.	
3—	100 kva.	GE H.K. 1/60/4800/6920Y pri. 480 sec.	
3—	100 kva	G.E., 2400/4160Y—120x240	
3—	50 kva	WEST CHP. 4160/7200Y, 120/240	

ERIE ELECTRIC CO., INC.
28 Mechanic St. Buffalo 2, N. Y.

Circle 34S on Reader Service Card

MODERN POWER BOILERS

2—Babcock & Wilcox	—265,000#/s—	750 psi
1—Combustion-Engineering	—110,000#/s—	675 psi
1—Riley	—60,000#/s—	456 psi
1—Babcock & Wilcox	—100,000#/s—	450 psi
1—Babcock & Wilcox	— 90,000#/s—	263 psi
1—Combustion-Engineering	— 75,000#/s—	250 psi
1—Babcock & Wilcox	— 70,000#/s—	450 psi
1—Riley	— 60,000#/s—	263 psi
1—Combustion-Engineering	— 54,000#/s—	250 psi
2—Combustion-Engineering	— 50,000#/s—	250 psi
1—Babcock & Wilcox	—45,000#/s—	450 psi
1—Foster-Wheeler	— 40,000#/s—	200 psi
2—Babcock & Wilcox	—40,000#/s—	250 psi
1—Babcock & Wilcox	— 27,500#/s—	450 psi
1—Edgemoor	— 25,000#/s—	450 psi
2—Riley	— 21,000#/s—	250 psi
2—Riley	— 18,000#/s—	200 psi

MIDWEST BOILER & TURBINE CO.
WARNER, NEW HAMPSHIRE

Circle 35S on Reader Service Card

CONVERSION & POWER EQUIPMENT

M-G SETS—3 Ph. 60 Cy.

Qu.	KW	Make	RPM	DC Volts	AC Volts
1	4000/4800	G.E. (3U)	450	250/300	2300/4000
1	2300	Whse. (3U)	720	600	2300/4000
1	2400	G.E.	450	300	2300/4160
1	1750/2100	G.E.	514	250/300	2300/4000
1	2000	G.E.	514	600	2300/4000
1	1500	G.E.	720	600	4000/13200
1	1500	Cr.-Wh.	720	100	2300/4160
1	1250	Whse.	720	600	2300/4160
1	1000	G.E.	900	600	2300/4000
1	1000	G.E.	720	250	2300/4160
1	1000	G.E.	900	300	4000/6600
1	500	G.E.	900	125/250	440
1	500	G.E.	900	250	2300/4000
1	500	G.E. (new)	1200	300	2300
1	400	C.W. (3U)	1200	125/250	2300
1	350	G.E.	900	125	440/4160
2	300	G.E.	1200	250	2300
1	300	Whse.	1200	600	2300/4160
1	200	G.E.	1200	250/275	440
1	200	G.E.	1200	250/275	2300/4160

MERCURY ARC RECTIFIERS

Qu	KW	Make	Type	DC Volts	AC Volts
2	150	G.E.	HY 30	115	208
1	150	G.E.	6RP	275	2300/4160

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	12500	Whse.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
1	2500	G.E.	25/62½	2300/2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
3	3333	Whse.	OISC	1	13800x2300
1	3600	A.C.	OISC	3	34500x2300
3	1000	G.E.	OISC	1	13800x460
2	833	A.C.	OISC	1	2400/4800V480

TURBO GENERATORS

Qu.	KW	Make	Description
1	1000	G.E.	Non Cond. 125#/5-15# B.P. 2300V.
1	2000	G.E.	Cond. 400#-750° 2400/4150V.

A.C. MOTORS — 3 Ph. 60 Cy. Slip Ring

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-979BB	4000/2400	1800
1	800	Whse.	CW	550	1778
1	800	G.E.	MT-428	2200	450
1	600	Whse.	CW-32D-15	440	1778
1	600	Whse.	CW	440	850
1	850	Whse.	CW	440	252
	(Tripped)				
1	500	Whse.	CW	2300	860

SQUIRREL CAGE

1	550/275	Whse.	CR-1115	2300	450/900
1	500	G.E.	FT-559T	2300	3600
2	300	Whse.	CSP-583H	440	3600
4	500	Whse.	CR-1216	2200	580
2	450	Elliott	5910	2300	1185
1	400	Whse.	CR-7181	4000/6600	3600
1	300	Whse.	CR-1007Z	2300	600
1	300	G.E.	KT-559A	2300	1775

SYNCHRONOUS

1	7000	G.E.	ATI	2200/6600	600
1	2500	G.E.	TS-6407	2200/4000	300
2	1750	G.E.	ATI	2200	3600
1	325	G.E.	ATI	440	1800

RE-NU-BILT BY

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Tel: OLDFIELD 3-3334

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MISS POWER EQUIPMENT SAYS,
"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed NEW and REBUILT MOTORS"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED

HP	Make	REBUILT Type	Speed
500	G.E. S.B. Open	IK	1200
400	West. S.B. Drip	CSP-681	1800
400	L.A. S.B. Splash	FX-1460	1800
400	G.E. S.B. Open	IK	1200
400	West S.B. Open	CS	900
250	West S.B. Drip	CS-22556H	1200
200	L.A. S.B. Splash	FX-1460	1800
200	G.E. S.B. Open	IK	1800
200	G.E. S.B. Open	IK	900
200	Cont. S.B. Splash	N-804	900
200	G.E. S.B. Open	IK	720
200	G.E. S.B. Open	KT-561	720
200	G.E. S.B. Open	IK	600
250	G.E. S.B. Open	KT	1800
250	West. S.B. Splash	CS-875	1800
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	G.E. S.B. Drip	K-6325	1800
200	West. S.S.B. Open	CS-855	1800
200	Cont. TEFCBB	NF-743X	1200
200	West. S.B. Open	CS	1200
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-156	1200
200	G.E. S.B. Open 2200 v.	IK	1200
200	G.E. S.B. Open	IK	900

CASH FOR YOUR SURPLUS

SEND YOUR LIST TODAY! NEW & USED Electrical Equipment

150	West. TEFCBB	CS-81205	1800
150	G.E. S.B. Drip	K-6324	1800
150	West. S.S.B. Open	CS-771-C	1800
150	Al. Chal. S.B. Open	AR	1800
150	West. S.B. Open 2200V	CS	1800
150	West. S.B. Drip	CR-772	1200
150	West. TEFCBB	CS-775	1200
150	G.E. S.B. Open	KT	1200
150	G.E. S.B. Open	KT-557	1200
150	Al. Chal. S.B. Open	AR-825	900
150	Cont. TEFCBB	N-743-X	900
150	Al. Chal. TEFCBB	AZ	900
150	F.M. S.B. Open	H-24A	900
150	G.E. S.B. Open	IK	900
150	G.E. S.B. Open	IK	720
125	G.E. TEFCBB	K	3600
125	Burke S.B. Open 440 Volt	N-505	3600
125	Reliance T.E.F.C. S.B.	AA-5084	1800
125	G.E. S.B. Open	IK	1800
125	G.E. S.B. Splash	K-365	1800
125	Al. Chal. S.B. Open	AR	1800
125	G.E. S.B. Open	KT-553	1200
125	Century S.B. Drip		1200
125	G.E. S.B. Open	IK	1200
125	Ideal S.B. Open	A-585	1200
125	F.M. S.B. Open	H	900
125	G.E. S.B. Open	IK	720

125	G.E. S.B. Open	IK	600
100	Al Chal. T.E.F.C. S.B.	ARZ-823	3600
100	C.W. S.B. Open 2300 Volt	SC-445	3600
100	L.A. S.B. Drip New	DGX-445	3600
100	U.S. S.B. Open 440 V	SC-704	3600
100	G.E. S.B. Open	KT-545	1800
100	G.E. S.B. Open	K-504	1800
100	Cont. TEFCBB XP	NP-505	1800
100	Al. Chal. S.B. Drip	ARW-823	1800
100	West. TEFCBB	CS-776	1200
100	G.E. S.B. Open	KT-547	1200
100	Ideal S.B. Drip New	A-584	1200
100	West. S.S.B. Open	CS-754C	900
100	Al. Chal. T.E.F.C. S.B. XP	23EA	900
100	F.M. S.B. Open	H28C	900
100	Al. Chal. S.B. Open	AR-823	900
100	F.M. S.B. Open	H	720
100	F.M. S.B. Open	H	600
75	G.E. S.B. Open	K-445	1800
75	Ideal S.B. Drip New	A-585	1200
75	Sterling BB Drip	SC-444	3600
75	L.A.B.B. Drip	DGX-445	1800

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Motors, Control Equipment, AC and DC Generators, MG sets and transformers
PHONE or WIRE us COLLECT
LARGE LINE OF SLIP RING MOTORS & CONTROLS

POWER EQUIPMENT CO.

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FOR SALE
Leslie & Elliott
STEEL SMOKE STACK

30" x 60' high
200' 6 x 7 guy wire.
New transition, rain shield & damper.
Reasonable offer acceptable
FRED E. HOOF DYE WORKS, INC
132-136 Putnam St. Paterson, N. J.

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WATER PUMP

Dean Brothers Pumps, Inc., Indianapolis, Indiana. Steam Operated—Size 14" x 8" x 12". No. 6320I—"Durable" Duplex, End Packed, Pot Valve Plunger Pump. 2.61 Gals/Stroke of One Side. Normal Capacity—40 Strokes per Min.—305 Gals per Min. Capacity.

FOWLER, DICK & WALKER
BINGHAMTON, NEW YORK

Circle 40S on Reader Service Card

COMPRESSORS
50 CFM to 4000 CFM

600 CFM 125 PSI 11¼-7x7 Joy Wn 102
686 CFM 100 PSI 14x13 Ing. ES-Chic. P.T.
877 CFM 125 PSI 17-10½x14 IR. XRB-CV
1055 CFM 110 PSI 18-11x12 Ch. Pn. OCE 175 HP 3-60-200 (Excellent)
1302 CFM 110 PSI 20/12x14 CP-OCE 215 HP West. Syn 3-60-2300 V
1721 CFM 110 PSI 23/14x16 IR-PRE2 300 HP GE Syn. 3-60-2200/4000 V
2200 CFM 110 PSI 25/15¾x18 IR-PRE2 335 HP G.E. Syn 3-60-4150 V
3146 CFM 110 PSI 22/13x14 Sull-WN4 500 HP GE Syn 3-60-2200V .8 PF
4255 CFM 100 PSI 34/20½x27 IR-PRE2 787 HP GE Syn. 3-60-2200
1655 CFM (actual) 100 PSI C300-300H Fuller 300 HP 3-60-440 V .8 PF

AMERICAN AIR COMPRESSOR CORP.
Chem. Road, North Bergen, N.J. UN 5-1397

Circle 38S on Reader Service Card

DIESEL GENERATORS

1—290 KW 120/240V DC GM 8-268A
4—250 KW 120/240V DC Enterprise DSG-6
2—240 KW 120/240V DC Worthington
8—100 KW 3/60/450 AC GM 3-268A

HUGO NEU CORPORATION
45 Nassau Street, New York 5, N.Y.

Circle 39S on Reader Service Card

FROM AIRCRAFT CARRIER "ENTERPRISE"

[4] 1000 KW GEARED TURBO-GENERATORS

For Condensing or Non-Condensing

1000 KW TURBO-GENERATOR COMPLETE WITH CONDENSERS CIRCULATING PUMPS CONDENSATE PUMPS AND SWITCH GEAR

GENERATOR: 1000 KW — type ATB-2 — G.E. — form H.L.—1250 KVA—3/60/450—1605 amps—3600 RPM—0.8 P.F.—field amps 87—typical serial No. 5358205—with 120 volt 11KW DC exciter—compound wound.

STEAM TURBINE: 1000 KW G.E.—type FSN-4R-FN30-85TG—rated 7964 RPM—exhaust 1 lb. absolute when condensing.

REDUCTION GEAR: 8-118—form A—RPM 7964/3600.

TURBINE STEAM PRESSURE: 375 lbs—175° F superheat-exhaust pressure 1 lb. absolute when condensing. Can be used condensing or non-condensing. Can be operated at reduced pressures.

BUILT AS MARINE UNITS USING FINEST MATERIALS. DRIP - PROOF CONSTRUCTION. UNITS ARE 16' LONG — 7'8½" WIDE. MOUNTED ON PRE-FAB SUB-BASE.

THE BOSTON METALS CO.

313 E. Baltimore St. Baltimore 2, Md.
ELGIN 5-5050 LEXINGTON 9-1900

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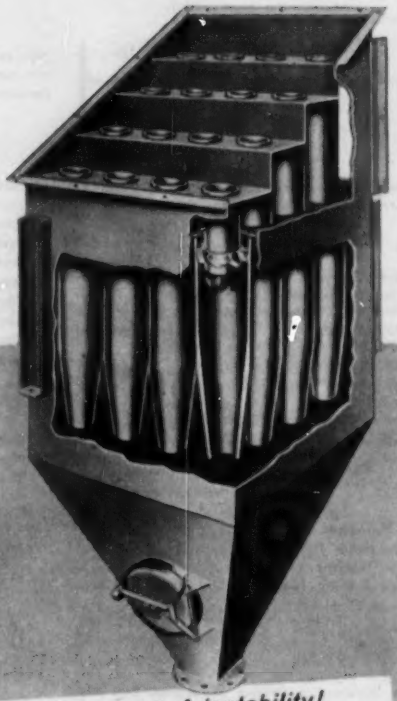

For cyclonic collection of dust or fly ash from all types of gases—hot or cold—no other equipment matches the multiple advantages you get in MULTICLONE Collectors. No wonder this small-tube equipment is so widely imitated—but only the genuine Multiclone combines so many important savings as these...

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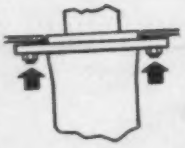
Multiclone Collectors pioneered the modern small-tube concept of cyclonic collection. The Multiclone small-diameter tubes combine highest collection efficiency with minimum risk of plugging—and separate not only large, medium and small particles, but also an unusually high percentage of the extremely small particles (10 microns and less)!



Compare Maintenance!

Multiclone cast iron tubes and vanes seldom require servicing or replacement. But when unusually abrasive service makes occasional servicing necessary, the tubes (one or more, as desired) can be quickly replaced by simply unbolting the old tube and installing a new one. The cast iron vanes are supported in a tapered seat—are equally easy to service!

Compare Adaptability!

Multiclone Collectors can frequently be placed in otherwise waste-space locations too small—or not properly shaped—for other types of collectors. The shape of the Multiclone can be varied—short and wide, long and narrow, or square—to fit varying space restrictions. Moreover, the unit can be installed with side-inlet, side-outlet—or side-inlet, top-outlet—to fit plant layouts... and only a single inlet and outlet duct is required to service an entire bank of tubes. These multiple advantages add up to important savings in installation, in insulating costs, in space conservation!

Compare Compactness!

In addition to greater space adaptability, Multiclone Collectors also are unusually compact in themselves. For comparable capacity and performance, they require less floor space and less cubic space than do any other cyclonic units. Translate these space savings—plus Multiclone's adaptability to odd-shaped areas—into today's high costs for plant construction and you readily see how important Multiclone compactness really is!

The Above Are Only A Few of the many important advantages you get when you install Multiclone Collectors. Still more are outlined in Multiclone literature that will gladly be sent on request. Write or phone our nearest office for this helpful information!

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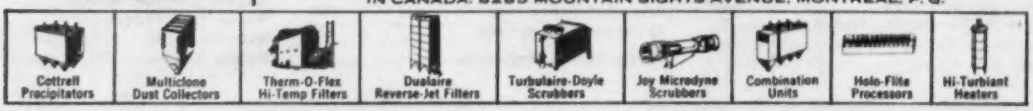

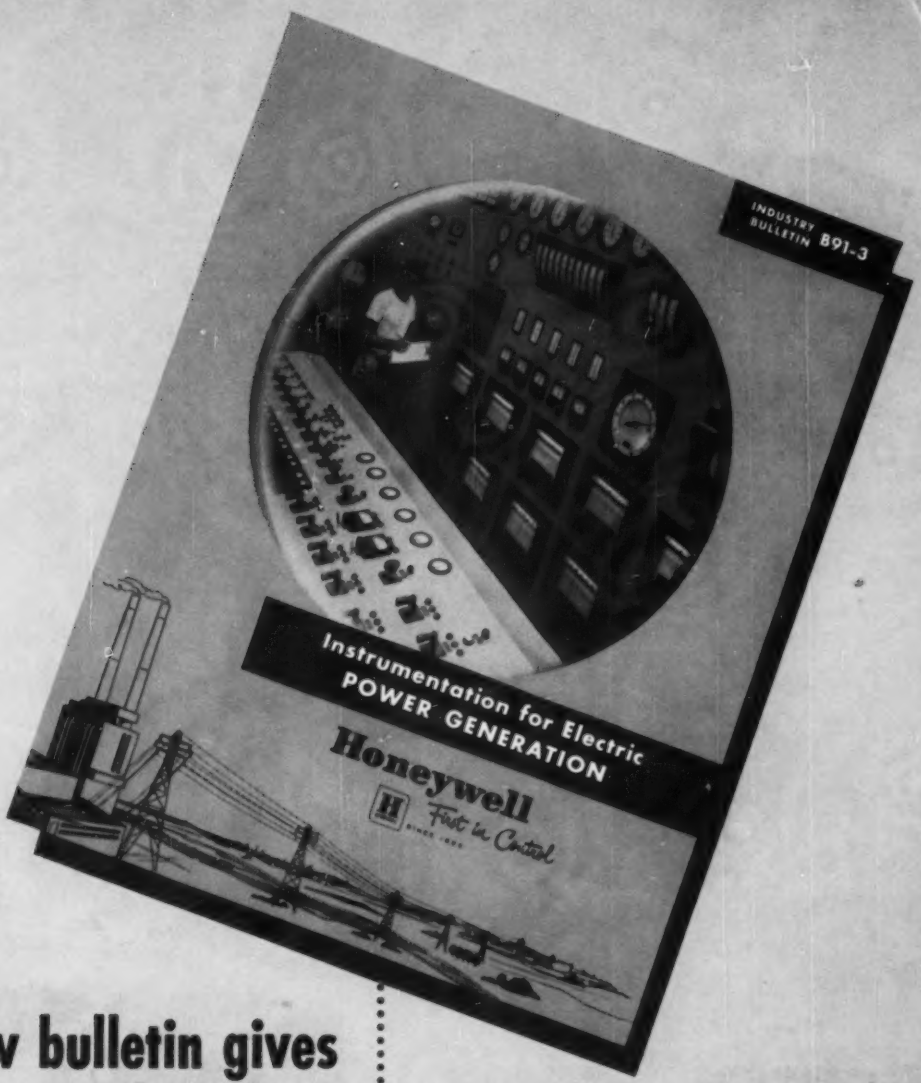

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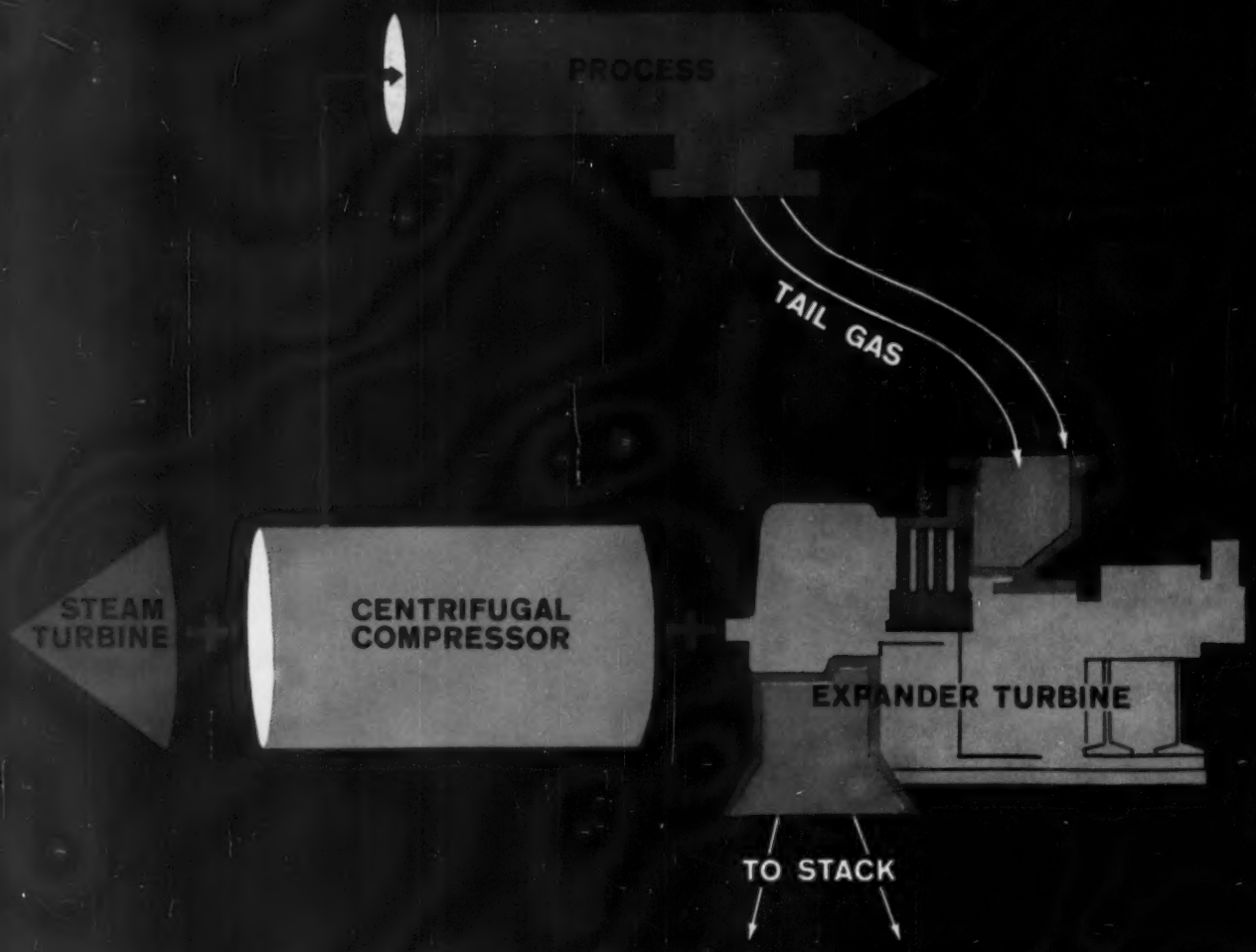

TAIL GAS WAGS PROCESS, SAVES ⅔'s POWER COSTS

In less serious moments we call it "tail-wagging." Actually, it's the art of taking substantial amounts of power from process exhaust or "tail" gases. By making the tail wag the dog . . . putting this power back into the process . . . major increases in efficiency can be obtained.

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Recent developments in design, materials and manufacture have now made "tail-wagging" with high horsepower, high temperature turbine gas expanders possible for a variety of processes. At Worthington we have answers you need to make a complete study of this new opportunity for process plant economy. For information about "tail-wagging" (turbine gas expanders and their application) please write Worthington Corporation, Expander Section (48-10), Wellsville, New York.

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